OVERSEER Nutrient Budget Review

For: Environment Southland – Fawna Farms Ltd

Prepared by: Nicky Watt, CNMA

Date: 25th October 2022

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Introduction

1. Regarding the consent application for Fawna Farms Ltd, I have reviewed the following OVERSEER ® Nutrient Budget (OVERSEER) files:
   a) A Fawna Farms YE20 (v1)
   b) B IFS Growth YE20 (v1)
   c) C Fawna Farms Proposed (v1)
   d) D IFS Growth Proposed (v1)

2. Along with the files I have reviewed the following accompany report: "OverseerFM farm system modelling to support a consent for expanded dairy" prepared by Mo Topham , AgriAce Consulting Ltd and reviewed by Miranda Hunter, Roslin Consultancy Ltd. I have completed a robustness check on the file for sensibility based on data available and checked to ensure the modelling aligns with the OVERSEER Best Practice Data Input Standards for v6.4.3.

3. 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.

4. A 'sensibility test' has been undertaken on the Fawna Farms 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.

5. 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 Overseer FM files submitted and 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 are no deviations from the BPDIS.

3. The combination of the YE20 models for Fawna and IFS had a total of 825.5 ha and an effective area of 810.6 ha. The combined Proposed models for Fawna and IFS had a total area of 825.5 ha and an effective area of 530.3 ha. The combination of the YE20 models for Fawna and IFS had a revised stocking rate of 27.6 RSU/ha for dairy cows on the effective dairy grazed pasture area. The combined Proposed models for Fawna and IFS had a revised stocking rate of 26.8 RSU/ha for the

effective dairy grazed pasture area or a 2.9 % decrease in RSU/ha for effective dairy grazed pasture area. The combination of the YE20 models for Fawna and IFS had a total revised stocking rate of 16.3 RSU/ha for all animals on the effective area. The combined Proposed models for Fawna and IFS had a total revised stocking rate of 22.5 RSU/ha for the effective area or a 27.6% increase in RSU/ha for effective area (see Table 1a below).

4. Reviewing the NZ Dairy statistics for the 2019/2020 season, shows the average milk solids production on this property for the Fawna YE20 model at 465.3 kgMS/cow and 1266 kgMS/ha is respectively higher than the Southland Regional average of 414 kg MS/cow and higher than the Southland Regional average of 1,133 kgMS/ha. The Fawna Prop model at 387.1 kgMS/cow and 948 kgMS/ha are respectively lower than the Southland Regional average of 414 kg MS/cow and lower than the Southland Regional average of 1,133kgMS/ha.

5. The dairy cow stocking rate for Fawna YE20 and Fawna Prop models at 2.7 cows/ha and 2.5 cows/ha are both respectively lower than the Southland average for the 2019/2020 season of 2.71 cows/ha (Southland).

6. It is noted that the Dairy cows have been modelled as lactating cows and since there is a drying-off date in May the cows are pregnant but no longer lactating from this date through June and July until they have calved. As there is a mean calving date for August the model then assumes there is an average number of lactating cows (cows calved and now in milk) for August onwards.

Table 1: Summary of Production and stocking rate

	Fawna YE20[1]	IFS YE20[2]	Fawna Prop[3]	IFS Prop[4]
Total Ha	370.9	454.6	536.8	288.7
Effective Area (ha)	365.3	391.6	530.3	-
Effective Pasture Area (ha)	330.9	362.4	452.5	-
KgMS	418777	-	480000	-
MS kg/ha grazed	1266	-	948	-
MS kg MS/cow	465.3	-	387.1	-
Dairy RSU	9126	-	12131	-
Dairy RSU/ha (pasture area)	27.6	-	26.8	-
Total RSU	9872	2483	12598	-
Total RSU/ha	27.0	6.3	23.8	-
Lactation Length	266	-	266	-
Cows/ha (per ha grazed)	2.7	-	2.5	-
Cows October	870	-	1200	-
Cows June	50	-	955	-
Cows July	320	-	1240	-
Replacements June	220	740	-	-
Replacements July	0	695	-	-
Replacement RSU	621	1447	416	-
Beef RSU	125	-	51	-
Sheep RSU	-	1036	-	-
N lost kg/ha/yr	47	31	54	3

A Fawna Farms YE20 (v1)- Fawna YE20[1]
B IFS Growth YE20 (v1) – IFS YE20[2]
C Fawna Farms Proposed - Fawna Prop[3]
D IFS Growth Proposed – IFS Prop[4]

Table 1a: Summary of combined production and stocking rate

	YE20	Proposed
Total Ha	825.5	825.5
Effective Area (ha)	756.9	530.3
Effective Pasture Area (ha)	706.3	452.5
KgMS	418777	480000

MS kg/ha grazed	1266	948
MS kg MS/cow	465.3	387.1
Dairy RSU	9126	12131
Dairy RSU/ha (pasture area)	26.5	27.8
Total RSU	12355	12598
Total RSU/ha	16.3	22.5
Lactation Length	266	266
Cows/ha (per ha grazed)	2.7	2.5
Cows October	870	1200
Cows June	50	955
Cows July	320	1240
Replacements June	960	-
Replacements July	695	-
Replacement RSU	2068	416
Beef RSU	125	51
Sheep RSU	1036	-
Total N Lost (kg/yr)	31706	29565
N lost (kg/ha/yr)	38.4	35.8

7. The combination of the YE20 models for Fawna and IFS showed an area of 28.6 ha of swedes grazed in the winter 2020 by dairy cows, beef, and replacements and 22 ha of fodder beet grazed in the winter by beef and replacements. This is a total of 50.6 ha of winter feed grown and grazed by dairy cows, beef, and replacements. The combined Proposed models for Fawna and IFS had 53.7 ha of swede grazed in the winter by dairy cows and replacements. This is a total of 53.7 ha of winter crops grazed by dairy cows and replacements. This is a 5.8 % increase in winter crop grown in the Proposed model (see Table 2a below). It was noted in the supplementary report that there was a maximum area of 58.4 ha of winter crop grazed during the Reference Period.

Table 2: Crop Details

	Fawna YE20	IFS YE20	Fawna Prop	IFS Prop
Fodder Beet Crop (ha)	-	22	-	-
Fodder Beet Yield (tDM/ha)	-	20	-	-
When grazed	-	June to Sept	-	-
Grazed By	-	Beef and Dairy Grazing	-	-
Swedes Crop (ha)	21.4	7.2	53.7	-
Swedes Yield (tDM/ha)	12	12	12	-
When grazed	June to Sept	June to Sept	June to Sept	-
Grazed by	Dairy & replacements	Beef & dairy grazing	Dairy and replacements	-

Table 2a: Combined Crop Details

	YE20	Proposed
Fodder Beet Crop (ha)	22	-
Fodder Beet Yield (tDM/ha)	20	-
When grazed	June to Sept	-
Grazed By	Beef and Dairy Grazing	-
Swedes Crop (ha)	28.6	53.7
Swedes Yield (tDM/ha)	12	12
When grazed	June to Sept	June to Sept
Grazed by	Dairy, Beef & replacements	Dairy and replacements

8. The soil areas are with margin of error for all soils (see Table 3 below).

Table 3: Soil Details

	Fawna YE20	IFS YE20	Fawna Prop	IFS Prop

Hedge_4a.1	174.2	-	174.2	-
Auchr_9b.1	73.9	302.4	191.8	184.5
Apar_6a.1	66.6	-	66.6	-
Eure_22a.1	20.1	-	20.1	-
Tuap_6b.2	19.6	-	19.6	-
Ihak_23a.1	10.9	-	10.9	-
Malok_3a.1	-	66.2		66.2
Waiau_3a.1	-	11.6	11.5	--
Makar_3b.1	-	11.4	11.5	-

9. Supplements are imported to meet cow demand (see Table 4 below). Pasture silage has been made where there was a surplus of pasture. The combination of the YE20 models for Fawna and IFS had a pasture growth calculated at 16.1 tDM/ha and the combined Proposed models for Fawna and IFS had a pasture growth of 15.9 tDM/ha for dairy pasture. This is a 1.2% decrease in pasture growth. The N used on all pasture blocks for the combination of the YE20 models for Fawna and IFS was 219 kgN/ha for non-effluent and effluent areas compared to 189 kgN/ha for effluent and non-effluent areas in the combined Proposed models for Fawna and IFS. This is a 13.7 % decrease in N fertiliser used. There is expected to be 35.6% less supplement imported per hectare, and 20% more silage harvested in the combined Proposed models for Fawna and IFS compared to the combination of the YE20 models for Fawna and IFS (see Table 4a below).

Table 4: Supplements imported and Harvested

	Fawna YE20	IFS YE20	Fawna Prop	IFS Prop
Supplements Imported (tDM)	655	-	300	-
Supplements Imported Effective Area (tDM/ha)	1.79	-	0.56	-
Silage Harvested (tDM)	224	288	450	-
Silage Harvested Eff Pasture (tDM/ha)	0.61	0.73	0.85	-
Total Area (ha)	370.9	454.6	536.8	288.7
Effective Area (ha)	365.3	391.6	530.3	-
Effective Pasture Area (ha)	343.9	362.4	452.5	-
Dairy RSU	9126	-	12131	-
Dairy RSU/ha (eff pasture area)	26.5	-	26.8	-
Total RSU	9872	2483	12598	-
Total RSU/ha	27.0	6.3	23.8	-
Cows/ha (per ha grazed)	2.7	-	2.5	-
N Fertiliser applied non -effluent area(kgN/ha)	219*	-	189	-
N Fertiliser applied effluent Area (kgN/ha)	219*	-	189	-
N Fertiliser on support pasture area (kgN/ha)	-	17	-	-
Pasture Growth support area (tDM/ha)	-	10.4	-	-
Pasture Growth dairy area (tDM/ha)	16.1	-	15.9	-

*This exceeds the 190 kgN/ha N cap

Table 4a: Combined Supplements imported and Harvested

	YE20	Proposed
Supplements Imported (tDM)	655	300
Supplements Imported Effective Area (tDM/ha)	0.87	0.56
Silage Harvested (tDM)	512	450
Silage Harvested Eff Pasture (tDM/ha)	0.68	0.85
Total Area (ha)	825.5	825.5
Effective Area (ha)	756.9	530.3
Effective Pasture Area (ha)	706.3	452.5
Dairy RSU	9126	12131
Dairy RSU/ha (eff pasture area)	26.5	27.8
Total RSU	12355	12598
Total RSU/ha	16.3	22.5
Cows/ha (per ha grazed)	2.7	2.5
N Fertiliser applied non -effluent area(kgN/ha)	219	189
N Fertiliser applied effluent Area (kgN/ha)	219	189

N Fertiliser on support pasture area (kgN/ha)	17	-
Pasture Growth support area (tDM/ha)	10.4	-
Pasture Growth dairy area (tDM/ha)	16.1	15.9

Overseer Outputs

10. The N lost to water for the combination of the YE20 models for Fawna and IFS was 38.4 kgN/ha/yr (31706 kgN/annum) compared to 35.8 kgN/ha/yr (29565 kgN/annum) for the combined Proposed models for Fawna and IFS which is an 6.8% reduction in the total N loss. The P lost for the combination of the YE20 models for Fawna and IFS showed was 0.52 kgP/ha/yr (432 kgP/annum) compared to 1.29 kgP/ha/yr (1069 kgP/annum) for the combined Proposed models for Fawna and IFS which is a 39.4% decrease in total P loss (see Table 5a below). It is assumed that the information provided in this farming system is modelled as a viable farming system, using actual stock and fertiliser inputs.

Table 5: OVERSEER outputs

Overseer v6.4.3	Fawna YE20	IFS YE20	Fawna Prop	IFS Prop
N lost to water kg/ha/yr	47	31	54	3
Total N lost kg/farm	17607	14099	28835	730
P lost kg/ha/yr	1.1	1.5	1.1	0.1
Total P lost kg/farm	401	668	613	35
Other sources – N	695	79	882	28
Other sources – P	176	59	217	3

Table 5a: Combined OVERSEER outputs

Overseer v6.4.3	YE20	Proposed
N lost to water kg/ha/yr	38.4	35.8
Total N lost kg/farm	31706	29565
P lost kg/ha/yr	1.29	0.78
Total P lost kg/farm	1069	648
Other sources – N	774	910
Other sources – P	235	220

Change in block pools

11. The organic pool for N indicates the amount of N that is being either immobilized as seen by a 'positive' Organic pool N value or being mineralized as seen by a 'negative' Organic pool N value. N being immobilized is being used for increased biological activity and temporarily locked up. Once the microorganisms die the organic N in their cells is converted by mineralization and nitrification to plant available nitrate. It appears N is potentially being immobilized in all models (see Table 6 below).

12. The inorganic soil pool for P indicates the amount P that exceeds soil P maintenance as seen by a 'positive' inorganic soil P value or is less than the soil P maintenance requirements as seen by a 'negative' inorganic soil P value. Above maintenance P was applied to the Fawna YE20 model and slightly above maintenance was applied to the remaining models (see Table 6a below).

Table 6: Change in block pool (N)

	Fawna YE20	IFS YE20	Fawna Prop	IFS Prop
Organic Pool	118	17	64	0
Inorganic Mineral	0	0	0	0
Inorganic Soil Pool	4	3	16	0

Table 6a: Change in block pool (P)

	Fawna YE20	IFS YE20	Fawna Prop	IFS Prop
Organic Pool	11	9	12	0
Inorganic Mineral	3	1	2	0
Inorganic Soil Pool	29	5	7	0

Rain/clover N Fixation

All plants, including forage crops, need relatively large amounts of nitrogen for growth and development. Biological nitrogen fixation is the term used for a process in which nitrogen gas (N2) from the atmosphere is incorporated into the tissue of certain plants. Only a select group of plants can obtain N this way, with the help of soil microorganisms. Among forage plants, the group of plants known as legumes (predominantly Clover in NZ pastures) are well known for being able to obtain N from air N2. The OVERSEER Technical Manual – Characteristics of Pasture, April 2015 indicates that biological N fixation is based on total pasture production and includes the fertiliser induced reduction in N fixation.

13. The Biological fixation for the combination of the YE20 models for Fawna and IFS is 66 kg/ha /year compared to the the combined Proposed models for Fawna and IFS at 60 kg/ha/year. This is a 9.1% decrease (see table 7a below).

14. The N added to pasture for the combination of the YE20 models for Fawna and IFS was 108 kgN/ha compared to 123 kgN/ha for the combined Proposed models for Fawna and IFS (a 12.2 % increase in N used).

15. The decrease in biological fixation in the the combined Proposed models for Fawna and IFS can largely be explained by the 12.2 % increase in N fertiliser applied.

Table 7: Biological fixation

	Fawna YE20	IFS YE20	Fawna Prop	IFS Prop
Total Area (ha)	370.9	454.6	536.8	288.7
Biological Fixation (kg/ha/yr)	78	57	91	1
Average N applied to whole farm kg/ha/yr	208 (219 to effluent and non-effluent pasture)	20 (17 to pasture)	168 (189 to pasture)	0

Table 7a: Biological fixation

	YE20	Proposed
Total Area (ha)	825.5	825.5
Biological Fixation (kg/ha/yr)	66	60
Average N applied to whole farm kg/ha/yr	104 (108 to pasture)	109 (123 to pasture)

Pasture Production

16. The average effluent N inputs for the YE20 models for Fawna was 95 kgN/ha from liquid and solid effluent to 67 ha of pasture (see table 8 below). The average effluent N inputs for Proposed Fawna model was 56 kgN/ha from liquid and solid effluent to 158 ha of pasture.

17. Fertiliser inputs of N, for the combination of the YE20 model for Fawna, to effluent and non-effluent pasture was 219 kgN/ha (see Table 8 below). The fertiliser inputs of N to pasture onto effluent and non-effluent area was 189 kgN/ha pasture in the Fawna Proposed model (see Table 8 below).

18. Liquid effluent is applied onto the dairy pasture blocks for the Fawna YE20 and Fawna Prop models, throughout the year, using a 12-24 mm application method. Solid effluent, from the pond, was applied September to April to the effluent blocks only and separated solids spread in December to all the pasture blocks (including effluent blocks) for Fawna YE20 and Proposed models.

19.

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

	Fawna YE20	Fawna Prop
Effluent Liquid Area (ha)	67	158
Effluent Solids Area (ha)	330.0	476.6
Pasture Growth (tDM/ha/yr)		
Effluent	16.1	15.9
Non-Effluent	16.1	15.9
N Fertiliser inputs (kg/ha/yr)		
Effluent	219	189
Non-Effluent	219	189
N Effluent Inputs (kg/ha/yr)		
Effluent	95	56
Non-effluent (includes solids)	7	6
Total N Inputs (kgN/ha/yr)		
Effluent	314	244
Non-Effluent	226	195

20. The pasture production for all models have been modelled as varying based on topography, climate, and development status.

21. Fertiliser inputs of N are moderate for the combination of the YE20 models for Fawna and IFS and for the combined Proposed models for Fawna and IFS (see Tables 7a and 8).

22. It is assumed the combination of the YE20 models for Fawna and IFS represent the actual farm system with actual stock, crop area and fertiliser inputs, it is assumed that the pasture production is accurate and reasonable.

23. Long term pasture growth in Southland between 1979 and 2012 indicated that average pasture growth for newer pastures was 12.7T DM/ha/yr. Growth rates for Wallacetown were 14.3 tDM/ha for the 2019/2020 season allowing for 176 kgN/ha.

24. The dairy pasture production for the combination of the YE20 models for Fawna and IFS was 16.1 tDM/ha compared to 15.9 tDM/ha for the Proposed model which is respectively 26.8% and 20.1% higher than the Southland average. The dairy pasture production for the combination of the Fawna YE20 model was 16.1 tDM/ha compared to 15.9 tDM/ha for the Fawna Proposed model which is respectively 11.2% and 10.6% higher than the Wallacetown area average (see Tables 4 and 8 above).

25. The Fawna YE20 model: Allowing for the Overseer model assuming an average metabolisable energy (ME) value of 10.5 MJME/kgDM for pasture and South Island pastures have a ME value closer to 11 MJME/kgDM the models output of pasture growth would drop by 4.5%. Also, the model had used actual data and is assumed that pasture renewal has occurred, and new pasture

can account for a 15-20% improvement in pasture growth. Also 0.5 tDM/ha would come from the extra N fertiliser applied (43 kgN/ha X 12 kgDM/kgN applied). This more than accounts for the higher pasture growth.

26. Fawna Proposed model: The small drop in pasture growth can be accounted for in the 13.9 % decrease in N applied to pasture and 11.9% decrease in RSU/ha of pasture grazed by all animals.

27. The animal distribution is modelled as 'No difference between blocks' and 'Same as ratio of total animal intake '.

Mitigations Modelled

28. Reporting out lined the following: As described in the Nutrient Budget Report for Fawna Farms Ltd prepared Mo Topham (page 7 of the 'OverseerFM farm system modelling to support a consent application for expanded dairy), there are several mitigation measures indicated to mitigate N/P loss that have been included in the Proposed modelling. 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 scenario

Decrease in total RSU from the combined YE20 models to the combined Proposed models	No, according to the figures in OverseerFM the total RSU has increased by 243 (1.9%) or an increase Total RSU/ha from 16.3 RSU/effective ha to 22.5 RSU/effective ha (27.6% increase)
Decrease in grazing area	Yes the effective grazing area has decreased by 26% from 756.9 ha to 530.3 ha.
Decrease in RSU/ha in the dairy grazed pasture	Yes, the dairy RSU/ha of grazed pasture has increased slightly from 27.6 RSU/ha to 26.8 RSU/ha or a 2.9% decrease in RSU/ha.
Decrease in N applied to winter crops	Yes, N fertiliser applied to winter crops has decreased from rates of 117/138/175 kgN/ha to proposed levels of 90 kgN/ha to winter grazed crops
Removal of sheep and beef	Yes, there are no sheep or beef animals(other than breeding bulls) in the Proposed models
Decrease in P applied	Yes, well above maintenance P was applied to the Fawna YE20 model and slightly above maintenance was applied to the Fawna Proposed model.
Decrease in imported feed	Yes, there is expected to be 35.6% less supplement imported per hectare, and 20% more silage harvested in the Fawna Proposed model compared to the combination of the YE20 models

29. All mitigations identified in the OverseerFM report have been modelled correctly.

30. 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.

31. Some good management practices assumed in Overseer are maintain accurate and auditable records of annual farm inputs, outputs and management practices (Overseer output is only as good as the data entered); Fertiliser is being applied according to the Fertmark and Spreadmark

Codes of Practice; Feed is stored to minimise leachate and soil damage; Compliant effluent systems as defined by DairyNZ; Stock exclusion from water ways; Irrigation efficiency greater than 80%; farm race and bridge/culvert nutrient runoff is directed to paddocks; grazing managed to minimise losses from critical source areas.

32. Overseer will account for bad practices such as nitrogen (N) applied that exceeds the plants' ability to absorb the excess N, application of N in the winter, high stocking rates, land left fallow between crops and irrigating high water application rates causing N drainage to name a few.

33. The Overseer modelling completed for this farm does not have any of the 'Bad Practices' as suggested in paragraph 32, and it would be assumed the FEMP would cover any good management practices (not limited to) outlined in paragraph 31.

CONCLUDING COMMENTS

Determination of the robustness of the nutrient loss to water

34. 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?

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

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

36. The Biological fixation for the combination of the YE20 models for Fawna and IFS is 66 kg/ha /year compared to the the combined Proposed models for Fawna and IFS at 60 kg/ha/year. This is a 9.1% decrease.

37. The N added to pasture for the combination of the YE20 models for Fawna and IFS was 108 kgN/ha compared to 123 kgN/ha for the combined Proposed models for Fawna and IFS (a 12.2 % increase in N used).

38. The decrease in biological fixation in the the combined Proposed models for Fawna and IFS can largely be explained by the 12.2 % increase in N fertiliser applied.

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

39. The rainfall and soil information have been entered based on protocols for the location and soil type selected. The combination of the YE20 Model soil areas are within acceptable marginal differences when compared to the combined Proposed model soils.

Production and stocking rate

40. Reviewing the NZ Dairy statistics for the 2019/2020 season, shows the average milk solids production on this property for the Fawna YE20 model at 465.3 kgMS/cow and 1266 kgMS/ha is respectively higher than the Southland Regional average of 414 kg MS/cow and higher than the Southland Regional average of 1,133 kgMS/ha. The Fawna Prop model at 387.1 kgMS/cow and 948 kgMS/ha are respectively lower than the Southland Regional average of 414 kg MS/cow and lower than the Southland Regional average of 1,133kgMS/ha.

41. The dairy cow stocking rate for Fawna YE20 and Fawna Prop models at 2.7 cows/ha and 2.5 cows/ha are both respectively lower than the Southland average for the 2019/2020 season of 2.71 cows/ha (Southland).

42. It is assumed that the Fawna YE 20 Dairy model was based on actual year end information.

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

43. Long term pasture growth in Southland between 1979 and 2012 indicated that average pasture growth for newer pastures was 12.7T DM/ha/yr. Growth rates for Wallacetown were 14.3 tDM/ha for the 2019/2020 season allowing for 176 kgN/ha.

44. The dairy pasture production for the combination of the YE20 models for Fawna and IFS was 16.1 tDM/ha compared to 15.9 tDM/ha for the Proposed model which is respectively 26.8% and 20.1% higher than the Southland average. The dairy pasture production for the combination of the Fawna YE20 model was 16.1 tDM/ha compared to 15.9 tDM/ha for the Fawna Proposed model which is respectively 11.2% and 10.6% higher than the Wallacetown area average.

45. The Fawna YE20 model: Allowing for the Overseer model assuming an average metabolisable energy (ME) value of 10.5 MJME/kgDM for pasture and South Island pastures have a ME value closer to 11 MJME/kgDM the models output of pasture growth would drop by 4.5%. Also, the model had used actual data and is assumed that pasture renewal has occurred, and new pasture can account for a 15-20% improvement in pasture growth. Also 0.5 tDM/ha would come from the extra N fertiliser applied (43 kgN/ha X 12 kgDM/kgN applied). This more than accounts for the higher pasture growth.

46. Fawna Proposed model: The small drop in pasture growth can be accounted for in the 13.9 % decrease in N applied to pasture and 11.9% decrease in RSU/ha of pasture grazed by all animals.

47. The animal distribution is modelled as 'No difference between blocks' and 'Same as ratio of total animal intake '.

48. I have assumed an adequate level of robustness around the YE20 models of actual Overseer Modelling as they are based on actual farming systems, and with that, I have assumed actual stock and fertiliser inputs used.

    The data input protocols have been followed with some deviations. This leads to a **high** level of robustness for the relevant input data for example, climate, soils, and pasture type. Based on this, I consider that the robustness of the nutrient loss estimates for the Proposed model to be **high.**

    Note: The Fawna YE20: Milking platform 19 20 (Dairy model) does have N fertiliser applied at 219 kg/ha which is greater than the 190 kgN/ha N Cap.

References:

https://www.dairynz.co.nz/publications/dairy-industry/new-zealand-dairy-statistics-2020-21/

Overseer Definition of Terms, previously Technical Note 6. May 2016
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