BEFORE THE COMMISSIONERS APPOINTED BY THE SOUTHLAND REGIONAL COUNCIL

IN THE MATTER OF	the Resource Management Act 1991
AND	
IN THE MATTER OF	A Resource Consent Application to resource consent to discharge agricultural effluent to land from up to 640 cows, to take 85,800L/day of groundwater and to use land for two winter barns, a new agricultural effluent storage facility, and to establish a new dairy farm at 444 Springhills-Tussock Creek Road
REFERENCE NUMBER(S)	**APP-20222055**

EVIDENCE OF REUBEN JOHN EDKINS

OverseerFM Nutrient modelling

Introduction

1. My full name is Reuben John Edkins.

2. I hold the degree Master of Commerce (Agricultural) (Lincoln University) and have completed the Advanced Certificate of Sustainable Nutrient Management.

3. I am employed by Lumen Environmental as a Resource Management Advisor. In this role (as well as previously) I am subcontracted to Environment Canterbury to provide expertise primarily relating to the use of Overseer in regulation. As part of this role, I review Overseer analyses provided to Environment Canterbury as part of applications for resource consents. I have 9 years' experience in the use of Overseer as well as many years working in the agricultural and irrigation sectors.

4. I am a full member of the New Zealand Institute of Primary Industry Management.

5. I have reviewed the following OVERSEER ® Nutrient Budget (OVERSEER) files that relate to the consent application for Capil Grove Ltd:
    a. Stage 0 – Baseline -All farms (v1)
    b. Stage 3 – Proposed Dairy Milking w/lease (v1)
    c. Stage 4 - Revised Proposed Dairy Milking w/o (v1)

6. Along with the Overseer files, I have reviewed the following accompany reports:
    a. 03 - Irricon Overseer Audit May 2022 APP-20222055
    b. 03A - OverseerFM Audit Response APP-20222055

7. I have completed a sensibility test based on data available and checked to ensure the modelling aligns with the OVERSEER Best Practice Data Input Standards.

8. A 'sensibility test' has been undertaken on the Capil Grove Ltd nutrient budgets with the following five output screens from OVERSEER forming the basis of this assessment:
    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.

Overseer Outputs

9. The N lost to water for the *Stage 0 - Baseline - All farms (v1)* was 32 kgN/ha/yr (10,745 kgN/annum) compared to 27 kgN/ha/yr (9,214 kgN/annum) for the *Stage 3 - Proposed Dairy Milking w/ lease (v1)* model and to 27 kgN/ha/yr (9,091kgN/annum) for the *Stage 4 - Revised Proposed Dairy Milking w/o (v1)*.
    a. All reported in Overseer version 6.5.1

10. The P lost or P loss risk for the *Stage 0 - Baseline - All farms (v1)* was 1.9 kgP/ha/yr (633 kgP/annum) compared to 1.9 kgP/ha/yr (646 kgP/annum) for the *Stage 3 - Proposed Dairy Milking w/ lease (v1)* model and 1.9 kgP/ha/yr (656 kgP/annum) for the *Stage 4 - Revised Proposed Dairy Milking w/o (v1)*.
    a. All reported in Overseer version 6.5.1

Table 1: OVERSEER outputs

Overseer v6.5.1	*Stage 0 - Baseline - All farms (v1)*	*Stage 3 - Proposed Dairy Milking w/ lease (v1)*	*Stage 4 - Revised Proposed Dairy Milking w/o (v1).*
N lost to water kg/ha/yr	32	27	27
Total N lost kg/farm	10,745	9,214	9,091
P lost kg/ha/yr	1.9	1.9	1.9
Total P lost kg/farm	633	646	656
Other sources – N	172	316	364
Other sources – P	61	97	110

11. These loss rates are reasonable for the farm system and location.

Change in block pools

12. 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 (see Table 2 below).

13. 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 all models (see Table 6a below).

Table 2: Change in block pools (N)

	Stage 0 - Baseline - All farms (v1)	*Stage 3 - Proposed Dairy Milking w/ lease (v1)*	*Stage 4 - Revised Proposed Dairy Milking w/o (v1)*
Organic Pool	49	55	62
Inorganic Mineral	0	0	0
Inorganic Soil Pool	13	38	37

14. *These results show no major depletions and suggest that the modelled system is generally sound.*

Table 3: Change in block pools (P)

	Stage 0 - Baseline - All farms (v1)	*Stage 3 - Proposed Dairy Milking w/ lease (v1)*	*Stage 4 - Revised Proposed Dairy Milking w/o (v1)*
Organic Pool	8	9	8
Inorganic Mineral	1	1	1
Inorganic Soil Pool	20	15	18

a. *Stage 0 - Baseline - All farms (v1*) reports Olsen P changes ranging from a decrease of 1 unit (Hancox block) to an increase of 4 units (Tuffin block).

b. Stage 3 - Proposed Dairy Milking w/ lease (v1) reports Olsen P changes ranging from an increase of 1 unit (Sharks tooth) to an increase of 4 units (Sheep lease block and Tuffin Hill).

c. Stage 4 - Revised Proposed Dairy Milking w/o (v1) reports Olsen P changes ranging from an increase of 2 unit (Sharks tooth) to an increase of 4 units (Pasture dairy platform and Tuffin Hill).

15. These results in general show that P levels are being managed well and maintained so the modelling is sound in this regard.

Rain/clover N Fixation

16. The Biological fixation of Nitrogen for the Stage 0 - Baseline - All farms (v1) is 83 kgN/ha/yr compared to 75 for Stage 3 - Proposed Dairy Milking w/ lease (v1) and 84 for Stage 4 - Revised Proposed Dairy Milking w/o (v1). (see table4 below).

Table 4: Biological fixation

	Base	Stage 3 - Proposed Dairy Milking w/ lease (v1)	Stage 4 - Revised Proposed Dairy Milking w/o (v1)
Biological Fixation (kg/ha/yr)	83	75	86
Average N applied to whole farm kg/ha/yr	50 (152 to Hancox block) to 47 on Harwood.	Average of 95 (97 to sheep lease block, 74 to Sharks tooth which does not receive effluent, 80 to Tuffin Hill which does receive effluent and 106 to dairy platform which also receives effluent.)	Average of 80 (55 to Sharks tooth which does not receive effluent, 55 to Tuffin Hill which does receive effluent and 87 to dairy platform which also receives effluent.).

17. The variation in in biological fixation can be explained by the variation in applied N (including effluent) and overall suggests that the modelled farm systems are sound.

Pasture Production

Stage 0 - Baseline - All farms (v1)

	PASTURE/CROP	YIELD	PASTURE GROWTH (KG DM/HA)	PASTURE INTAKE (KG DM/HA)
HANCOX BLOCK	Ryegrass/white clover	-	17248	11416
HARWOOD	Ryegrass/white clover	-	14746	10322
ORIGINAL 444	Ryegrass/white clover	-	14746	10045
SHARKS TOOTH HILL	Ryegrass/white clover	-	17248	12073
TUFFIN BLOCK	Ryegrass/white clover	-	17248	12073
TUFFIN HILL	Ryegrass/white clover	-	17248	12073

Stage 3 - Proposed Dairy Milking w/ lease (v1)

Pasture/crops

Crop yield is only representative of crops sown in the reporting year. Pasture growth, intake supplements removed, utilisation and RSU only includes pasture and pas

	PASTURE/CROP	YIELD	PASTURE GROWTH (KG DM/HA)	PASTURE INTAKE (KG DM/HA)
PASTURE - DAIRY PLATFORM	Ryegrass/white clover	-	11937	6877
SHARKS TOOTH	Ryegrass/white clover	-	11848	10071
SHEEP LEASE BLOCK	Ryegrass/white clover	-	15110	10577
TUFFIN HILL	Ryegrass/white clover	-	11848	10071
BARLEY	Barley |	8 T DM/Ha	3152	2679
KALE	Kale | Pasture |	12 T DM/Ha	0	0

Stage 4 - Revised Proposed Dairy Milking w/o (v1)

	PASTURE/CROP	YIELD	PASTURE GROWTH (KG DM/HA)	PASTURE INTAKE (KG DM/HA)
PASTURE - DAIRY PLATFORM	Ryegrass/white clover	-	12281	7168
SHARKS TOOTH	Ryegrass/white clover	-	12281	10380
TUFFIN HILL	Ryegrass/white clover	-	12281	10380
BARLEY	Barley |	8 T DM/Ha	3477	2956

18. Pasture production in Overseer is a modelled output and the estimated pasture production value is essentially the amount of pasture Overseer determines is needed to meet the energy requirements of the animals once other sources such as crops and supplements have been accounted for.

19. It is unusual that the modelled pasture production is less in the proposed scenarios as more fertiliser N is being applied as well as dairy effluent.
20. This outcome suggests that the either the *Stage 0 - Baseline - All farms (v1)* was more efficient than the proposed scenarios, or perhaps more likely that the estimated demand is overstated.
21. Long term pasture growth in Southland between 1979 and 2012 indicated that average pasture growth for newer pastures was 12.7t DM/ha/yr.
22. The baseline scenario exceeds this estimate by a large margin while the proposed scenario is nearer this average despite increased N inputs and the opportunity for a high level of pasture management.

Production and stocking rate

23. All models have a total area of 340.1 ha with 313.4 ha effective.
    a. Stage 0 - Baseline - All farms (v1) had a total RSU of 6,581 and an RSU per productive ha of 21.
    b. Stage 3 - Proposed Dairy Milking w/ lease (v1) had a total RSU of 7,313 and an RSU per productive ha of 23.3.
    c. Stage 4 - Revised Proposed Dairy Milking w/o (v1) had a total RSU of 8,131 and an RSU per productive ha of 25.94.

24. It is odd that stocking rate is increasing but estimated pasture production is declining, particularly when N inputs are increasing.

25. Reviewing the NZ Dairy statistics for the 2021/2022 season, shows the average milk solids production per cow was 422kgMS which is much lower than the 550 kgMS/cow in the modelling.
26. Given this is a largely housed system and will milk essentially all year round, this comparison is potentially meaningless.

Summary of sensibility tests

27. The modelling is generally sound as assessed against these sensibility tests.
28. It is however not clear why the system is becoming less productive with regard to pasture production.

Appropriateness of the Overseer inputs

29. The Overseer FM files submitted and listed 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).

30. It is my opinion that there are some deviations from the BPDIS, notably that the areas of the soil siblings vary between all models.
31. The areas of the various soil siblings vary markedly which does not support a fair and meaningful comparison between the scenarios presented.
32. The area of the various soil siblings vary so greatly that the weighted average PAW_{60cm} of the scenarios as presented range from average 94.7mm to 85.3mm.
33. The confidence in the modelled outcome is low because of this variation and this is not consistent with good modelling practice when providing modelling to support consent applications.

Table 5: *Soil siblings and average weighted PAW for Stage 0 - Baseline - All farms (v1).*

Farm soils - Stage 0 - Baseline - All farms (v1)			
S-Map ref/Name	Drainage Class	Total area (ha)	PAW_{60cm}
Brax_4a.1	Poor	16.1	111
Kau_7a.1	Well	8.7	48
Makar_3b.1	Poor	83.9	108
Pukem_6a.1	Poor	185.5	93
Temar_3a.1	Imperfect	19.2	60
		313.4	94.7

Table 6: *Soil siblings and average weighted PAW for Proposed Dairy Milking w/ lease (v1).*

Farm soils - Stage 3 - Proposed Dairy Milking w/ lease (v1)			
S-Map ref/Name	Drainage Class	Total area (ha)	PAW_{60cm}
Brax_4a.1	Poor	6.6	111
Kau_7a.1	Well	8.7	48
Makar_3b.1	Poor	82.4	108
Pukem_6a.1	Poor	191	93
Temar_3a.1	Imperfect	24.7	60
		313.4	93.5

Table 7: *Soil siblings and average weighted PAW for Revised Proposed Dairy Milking w/o (v1).*

Farm soils -Stage 4 - Revised Proposed Dairy Milking w/o (v1)			
S-Map ref/Name	Drainage Class	Total area (ha)	PAW_{60cm}
Kau_7a.1	Well	8.7	48
Makar_3b.1	Poor	97.4	108
Pukem_6a.1	Poor	184.9	93
Temar_3a.1	Imperfect	22.4	60
		313.4	85.3

OVERSEERFM AUDIT – RESPONSE TO IRRICON REPORT QUESTIONS

34. A document was received by Environment Southland on the 24th of May 2022 titled *OVERSEERFM AUDIT – RESPONSE TO IRRICON REPORT QUESTIONS*, in response to questions raised by initial review of these models.
35. Below are my opinions of the responses received.

36. I have questions about the modelling of the dairy system and so I offer no opinion about the reply to question 1 *(Please explain why there is no mean calving or dry off dates for dairy cows*).

37. I consider question 2 (*Please explain why there is no harvest date for the barley crop in the Prop wo model*) to be addressed as there is a harvest date entered in the modelling I reviewed.

38. I consider the response to question 3 (*Please explain why the drawn area for the Base model differs to that of the proposed models*) is technically correct but leaves an issue unaddressed. It appears that the climate inputs are derived from the blocks as drawn and to meaningfully compare these scenarios, the climate inputs should be the same across the scenarios modelled as it appears they are not.

39. I consider the response to question 4 (*Please explain why the soil areas/types vary between the Baseline and the proposed models and between the proposed models*) is technically correct when preparing an individual analysis, but it misses the point in this situation.
40. For the council to be confident that the proposed scenarios will have less or no greater effect on the environment than the baseline activity, then this should be established using like for like modelling. The soil siblings and their properties should be consistent and currently they are not.

41. The fifth question asked was Please explain the high pasture harvest in the Base model for the beef area?
    a. Response: This is what the previous owner of the Hancox Block had told our client he had harvested. This was added to the baseline model as this is an actual farm system representation. It is best practice to do this.
42. The response is unclear and further clarification is needed.
43. Please clarify what is meant by the phrase "This is what the previous owner of the Hancox Block had told our client he had harvested".
    a. Does this relate to pasture production?
    b. It would highly unusual to adjust inputs into Overseer to try and achieve a pasture yield.

Other uncertainties arising from the review of the modelling provided.

44. There was little by the way of a farm system description provided other the bits of information contained in the report prepared by LEI (*01 - Application Capil Grove Farm 444*) and therefore there are issues present in the Overseer analysis that need further explanation.

45. These issues are listed below for each of the models reviewed:

Stage 0 - Baseline - All farms (v1)

46. Hancox Calves: End live weight for animals in June is left as default which is 205.5kg, which is inconsistent with the start liveweight with the Hancox R1 Beef which is left as default and is estimated at 181.13kg LWT by Overseer.
    a. Please explain this apparent inconsistency.

47. Tuffin R1: End live weight for animals in June is left as default which is 430.5kg, which is inconsistent with the start liveweight with the R2 Tuffin which is left as default and is estimated at 412.13kg LWT by Overseer.
    a. Please explain this apparent inconsistency.

48. Harwood Lambs, 200 Lambs kept from Weaning. These weigh 15kg at weaning in on 1st of January and have achieved a liveweight of 62.9kg by the end of June as modeled (default weight in in June).
    a. Is this correct?

49. There are 1577 lambs 'purchased' in on the 1st of September, but no lambs weaned from the MA mob.
    a. Is this correct?

Stage 3 - Proposed Dairy Milking w/ lease (v1)

50. No lambs being weaned are mentioned in this modelling, so does that mean all lambs are sold at weaning?

51. There is a crop block, with Barley sown in October of Reporting year.
52. If this is a recurring activity, there should be a corresponding block with Barley sown in October on Yr 1 and the block returned to pasture.
    a. Please clarify.

53. Time animals are on the covered wintering pad/shelter is not specified.
    a. Please clarify.

54. There is insufficient information provided about the proposed dairy system to determine if it is modeled correctly.
55. Currently:
    1. 505 Friesian Dairy cows start 1st of July at unspecified age or weight.
    2. Producing 277,750kgMS = 550kgMS/cow.
    3. No Mean Calving Date
    4. No Drying Off date
    5. Average weight = default of 462kg LWT.
    6. 335-day Lactation length.
    7. Nothing leaves the herd.
    8. Nothing joins the herd.
    9. No replacements are kept.
    10. This suggests that the cows arrive in milk and leave in milk 330 days later after producing 550kgMS.

56. Please explain in detail the proposed dairy system so that it can be assessed whether it is modeled correctly.

Stage 4 - Revised Proposed Dairy Milking w/o (v1)

57. Time animals are on the covered wintering pad/shelter is not specified.
    a. Please clarify.

58. There is insufficient information provided about the proposed dairy system to determine if it is modeled correctly.
59. Currently:
    b. 640 Friesian Dairy cows start 1st of July at unspecified age or weight.
    c. Producing 352,000kgMS = 550kgMS/cow.
    d. No Mean Calving Date
    e. No Drying Off date
    f. Average weight = default of 462kg LWT.
    g. 335-day Lactation length.
    h. Nothing leaves the herd.
    i. Nothing joins the herd.
    j. No replacements are kept.
    k. This suggests that the cows arrive in milk and leave in milk 330 days later after producing 550kgMS.

60. Please explain in detail the proposed dairy system so that it can be assessed whether it is modeled correctly.

61. The rainfall and PET differ for the Pasture – Dairy platform when compared with Stage 3 - Proposed Dairy Milking w/ lease (v1)
    a. Please explain why this varies.

62. There is a crop block, with Barley sown in October of Reporting year.
63. If this is a recurring activity, there should be a corresponding block with Barley sown in October on Yr 1 and the block returned to pasture.
    11. Please clarify.

64. Time animals are on the covered wintering pad/shelter is not specified.
    12. Please clarify.

CONCLUDING COMMENTS

65. The modelling passes most of the basic sensibility tests.
66. The modelling is broadly in accordance with best practice modelling guidance, with a few noted exceptions.
67. While there is a relatively large margin between the N loss rate of the baseline activity and the proposed activities, there are a number of uncertainties present in the modelling which undermines confidence in the modelled outcomes.
68. To meaningfully compare the models presented, the climate inputs and particularly the soils should be the same and they are not.
69. It is unexplained why the proposed scenarios produce less pasture than the baseline, suggesting an error somewhere.
70. The lack of clarity about the proposed dairy system means that it is not possible to determine if the system is modelled correctly.

71. The issues outlined in the previous sections need to be addressed before any definitive conclusions could be drawn.

Reuben Edkins

2nd of May 2023.

References:

https://www.dairynz.co.nz/publications/dairy-industry/new-zealand-dairy-statistics-2021-22/

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