BEFORE THE HEARINGS PANEL

IN THE MATTER of hearings on submissions concerning the Proposed One Plan notified by the Manawatu-Wanganui Regional Council

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SECTION 42A REPORT OF DR ANDREW KEITH MANDERSON ON BEHALF OF HORIZONS REGIONAL COUNCIL

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1. INTRODUCTION

My qualifications/experience

1. My name is Andrew Keith Manderson. I hold a Doctorate in Philosophy (Soil Science) from Massey University (Palmerston North, New Zealand), and a Bachelor of Applied Science Honours degree (Soil Science) also from Massey University. Both qualifications were achieved after returning from the workforce, where I spent six years on dairy, deer and sheep/beef farms.

2. For the past five years I have been employed as a Land and Environment Scientist by AgResearch, Palmerston North. Specialist areas of relevance include:
   - Soil and land survey expertise, including several farm surveys for farm planning purposes such as SLUI Whole Farm Plans (Mackay & Manderson 2007), a review of land and soil resource information for the Horizons Region (Hewitt et al. 2008), a journal review of soil information for New Zealand agriculture (Manderson & Palmer 2006), and the publication of survey manuals including the revised Land Use Capability Handbook (Lynn et al. 2009) and Introductory Guide to Farm Soil Mapping (Manderson et al. 2007).
   - Nutrient management and modelling. I hold Advanced Sustainable Nutrient Management certification from Massey University. Accreditation requires an advanced knowledge of nutrient cycling in New Zealand farming systems, with a particular emphasis on the advanced and correct use of OVERSEER® nutrient budgets software (hereafter called OVERSEER).
   - Farm systems planning with an emphasis on environmental integration. This includes papers for international conferences and journals (eg. Manderson et al. 2004, Manderson et al. 2007) and a variety of environmental farm plan projects including AgResearch's recent dairy conversion of Tokanui farm in the Waikato (Manderson 2009a).

3. I have read the Environment Court's practice note 'Expert Witnesses – Code of Conduct' and agree to comply with it.

My role in Proposed One Plan

4. My role in the Proposed One Plan involved the initial testing of the Farmer Applied Resource Management Strategy (FARMS) (Manderson & Mackay 2008), and subsequent revision of the FARMS Workbook (Manderson 2009b).

Scope of evidence

5. I have been asked to provide evidence on the following:
   i. Background and objectives of the first FARMS test farms project.
   ii. Overview of the FARMS test farms project case studies.
   iii. Results and key findings from the FARMS test farms project.
   iv. Recommendations for the refinement of the FARMS framework.
   v. Recommended protocols for nutrient budgeting within the FARMS framework.
   vi. The revised FARMS Workbook and combined resource consent application form.

2. EXECUTIVE SUMMARY OF EVIDENCE

Background and objectives of the first test FARMS project

6. AgResearch was contracted by Horizons Regional Council to undertake the first testing of FARMS (Farmer Applied Resource Management Strategies) according to the following objectives:
   i. Prepare six case study FARM Strategies using the FARM Strategy Workbook and a design template similar to SLUI Whole Farm Plans.
   ii. Identify and discuss any difficulties or inconsistencies encountered.
   iii. Clarify the steps taken to prepare a FARM Strategy.
   iv. Evaluate the economics of preparing and implementing FARM Strategies.
   v. Compare N-leaching loss limits calculated using two scales of LUC classification.
   vi. Provide recommendations for FARM Strategy development and improvement.

7. Six case studies using farms nominated by Horizons Regional Council were prepared. Cases represented a diversity of landscapes, regional climates and farming types (dairy, mixed farming, sheep and beef, and a dairy conversion) (see paragraph 15).

Results and key findings from the FARMS test farms project

8. Farming within nitrogen (N) loss limits would be achievable for all the case studies. Three cases had N-balances in credit (+1 to +9 kg N/ha/yr) and will require no further action to achieve Year 1 N-cap targets. The remainder had small deficits (-1 to -6 kg N/ha/yr) that can readily be balanced firstly by fulfilling other obligations (existing consent conditions, Clean Streams Accord obligations, 'other' FARMS Workbook requirements), and secondly by adopting a selection of best practice N-mitigations.

9. Twenty year N-loss limits were similarly achievable, albeit slightly more challenging because the 'sinking lid' nature of FARMS N-loss limits. Achievability is based on maintaining N-leaching at current levels. N-leaching changes over 20 years cannot be reliably predicted (losses may increase or decrease over time).

10. No major farming changes, such as reduced stocking rates, would be required to achieve case study N-cap targets.

11. All case studies had a variety of additional N-mitigation options available should they be required for future consideration. This suggests room for future growth. However, fewer options are available for lower intensity land uses such as sheep and beef.

12. Most case studies would achieve their N-cap targets by fulfilling other obligations. Excluding the conversion, all dairy case studies were non-compliant with existing effluent discharge consents and the Clean Streams Accord (effluent discharges, stock exclusion from waterways or stock crossings). Further, all cases except the dairy conversion would need further work to achieve full compliance with other FARMS Workbook requirements (ie. requirements other than those directly related to N-loss limits).

13. FARM Strategy preparation costs are estimated to range from $1,500 (*minimum* level), $2,300 to $5,000 (*medium* level) through to +$10,000 for *comprehensive* strategies. *Minimum* level strategies are likely to suffice in most cases.

14. Costs associated with achieving Clean Streams Accord compliance were significant for existing dairy cases ($3,875 to $61,610). These costs are excluded from the calculation of FARMS implementation costs.

15. Total cost of FARMS compliance could be minor or major depending on contestable big ticket items (Table below). Best case costs for case 6 are elevated by inclusion of a support block, while those for case 4 represent an extreme example due to farm size, farming intensity, and relative degree of existing farm development.

	FARMS implementation cost		
	Best case	**Worse case**	**Contestable items and comments**
Case study 1: Irrigated Dannevirke dairy farm	$1,500	$74,500	Bridge ($73,000)
Case study 2: Rain-fed Hukanui dairy farm	$1,560	-	-
Case study 3: Rain-fed sand country dairy/drystock	$0	$180,000	Two large silage bunkers ($180,000)
Case study 4: Rain-fed intensive hill sheep/beef, Pahiatua	$50,710	$455,175	(depends on how the farm is assessed)
Case study 5: Rain-fed dairy conversion, Pahiatua	$0	$27,700	(depends on N-response)
Case study 6: Irrigated mixed enterprise, Marton	$14,400	$29,220	Sheepyard effluent system ($10,000), stream fencing ($4,820)

16. The default cost of farming within N-loss limits alone is minor (ie. in isolation from all other compliance costs). In all but one case the default cost is nil. Case 5 was the exception, with costs dependent on N-inhibitor response rates ($27,700 assuming a conservative response).

17. The scale of Land Use Capability mapping influences the calculation of farm N-loss limits.

Recommendations for the refinement of the FARMS framework

18. A key recommendation from Manderson and Mackay (2008) was that the FARMS Workbook be redesigned to improve useability and applicability to the resource consent process (see Manderson 2009b for the revised FARMS Workbook 3).

19. Similarly, Workbook definitions, specifications and the wording of requirements were recommended for improvement. Several inconsistencies, errors and potential loopholes were identified, and have since been corrected in the revised Workbook (Manderson 2009b).

20. I also recommend that LUC surveyors be allowed to assign higher capability classifications for irrigated land, when the irrigation system is deemed permanent over

the duration of the consent (see Manderson & Mackay 2008 page 44), and according to updated LUC classification standards (see Lynn et al. 2009 page 86).

21. I recommend that policy or contingency be developed for properties that straddle *priority water management zone* boundaries. Currently it is not clear if such farms qualify under rule 13-1. Options are discussed in Manderson & Mackay (2008) on page 48.

22. Similarly, I recommend that clear policy is developed regarding the types of support block that can be included with a FARM Strategy. Applicants should retain discretion over the inclusion of support blocks. Options are discussed in Manderson & Mackay (2008) on page 50.

23. I recommend that applicants retain discretion over the scale of LUC mapping used to calculate N-loss limits. N-loss limits should initially be calculated using regional scale LUC (which is available for all farms in the Region), but with the option for farmers to have property-scale LUC prepared if they wish to do so. The implications of scale on the calculation of N-loss limits are discussed on pages 39-46 in Manderson & Mackay (2008).

Recommended protocols for nutrient budgeting within FARMS

24. Recommendations for the use of OVERSEER are more fully discussed on page 52 of Manderson & Mackay (2009).

25. I recommend that OVERSEER inputs be standardised by using consistent information where possible. For example, Horizons could supply rainfall information from a single consistent database, rather than having farmers and consultants use their own various and possibly non-validated sources of rainfall information.

26. I recommend that nutrient budgeting for FARMS only be carried out by accredited OVERSEER operators who have been trained in the correct use of the OVERSEER model and the development of N-mitigation strategies.

27. I recommend that accurate measures of total <u>farmed</u> area and effective area be used for OVERSEER modelling. This can be calculated off appropriate orthophotography or through appropriate GPS survey. The implications of using imprecise farm area information are discussed in Appendix 7.7 (page 78) of Manderson & Mackay (2008).

28. I recommend that an *Information Check* to be appended to each FARM Strategy, which lists all OVERSEER inputs, assumptions and justification for any change to default settings. Both the farmer and the OVERSEER operator are expected to sign the *Information Check* as being true and correct. An example is available on page 91 of Manderson & Mackay (2008).

29. I recommend that OVERSEER output tables be appended to a FARM Strategy. Output tables can be used to quickly identify inconsistencies in modelling or information provision.

30. I recommend regular monitoring and recording of fertiliser application, effluent application and irrigation as a condition of a FARM consent. These three variables can have a large effect on OVERSEER modelling, but reliable application information (rates, dates and amounts) can be difficult to source from farmers.

The revised FARMS Workbook and combined resource consent application form

31. AgResearch was contracted in March 2009 to refine the FARMS Workbook by integrating test farms recommendations, improving ease of use, and improving suitability for the resource consent application process.

32. FARMS Workbook 3 has been developed as a dual purpose resource, firstly as a tool for planning (ie. to help farmers plan and work towards compliance during the period before *priority water management zone* initiation dates) and secondly as a resource consent application form.

33. The revised FARMS Workbook (Manderson 2009b) has two components – a consent application form that requests information, and a detailed reference guide that provides instruction and explanation for each question or information request.

34. I believe the revised FARMS Workbook achieves a level of useability that does not require a default reliance on outside help for the preparation of a resource consent application, and a level of information rigour that is sufficient for the resource consent process.

3. EVIDENCE

Background and objectives of the first test FARMS project

35. Horizons notified the One Plan on May 31, 2007. Rule 13-1 proposes that all existing intensive land uses located within *priority water management zones*, AND all new conversions to intensive land uses anywhere within the Region, will be regulated as controlled activities that require resource consent.

36. Each farm that qualifies is required to submit a Farmer Applied Resource Management Strategy (FARMS) as part of the consent application process. This is to be prepared according to the requirements set out in The FARM Strategy Workbook (HRC 2007), which includes the calculation of farm nitrogen (N) loss limits according to Land Use Capability (LUC), the calculation of farm N-leaching losses using OVERSEER nutrient budgets, and a compliance assessment of farm activities relating to the quantity and quality of water.

37. Full Workbook compliance is required before a consent may be granted, and before predetermined dates assigned to each *priority water management zone*. Most qualifying farms will have one to five years to prepare and submit a FARM Strategy, except for Mangapapa and Mowhanau management zones which have a 1st April 2009 starting date.

38. AgResearch was contracted by Horizons Regional Council (HRC) in June 2007 to undertake the first testing of FARMS (referred to as the *FARMS test farms project*) according to the following objectives:

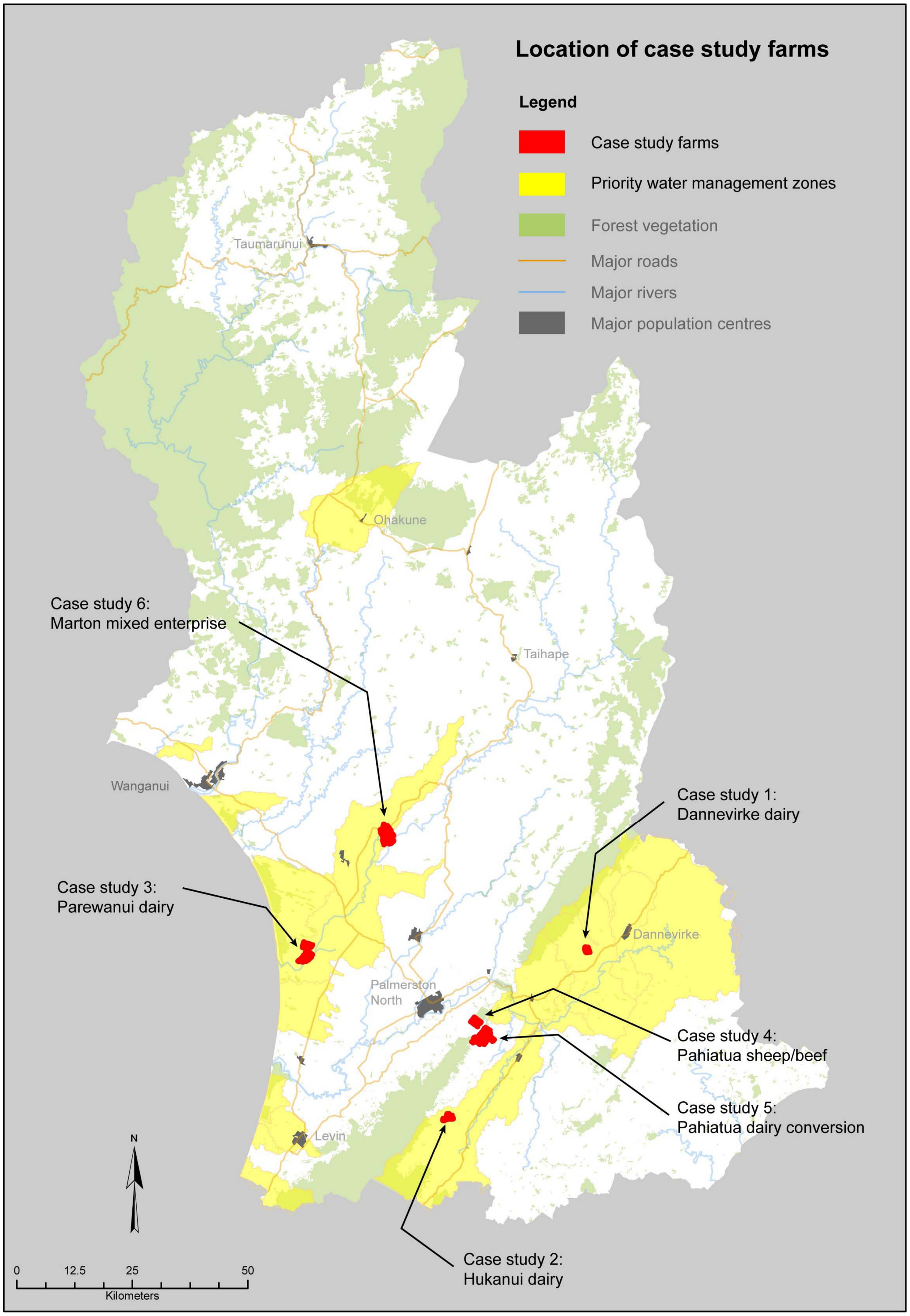
    i. Prepare six case study FARM Strategies using the FARM Strategy Workbook and a design template similar to SLUI Whole Farm Plans (ie. Mackay & Manderson 2007, Mackay 2007).
    ii. Identify and discuss any difficulties or inconsistencies encountered.
    iii. Clarify the steps taken to prepare a FARM Strategy.
    iv. Evaluate the economics of preparing and implementing FARM Strategies for each case study.
    v. Compare N-leaching loss limits calculated using two scales of LUC classification.
    vi. Provide recommendations for FARM Strategy development and improvement.

39. Full results of the *FARMS test farms project* are documented in the report Manderson & Mackay (2008).

Overview of the FARMS test farms project case studies

40. Seven properties were originally nominated by HRC to be the first FARMS test farms. Two later withdrew, one was added, and another was examined twice to investigate a dairy conversion. The largest (+2,560 ha) and most complex of the original seven was deferred because of disproportionate demands on the project budget and perceived limitations of the available OVERSEER release (which have since been resolved). The final six case studies cover a diversity of landscapes and farming types (Map 1). All were considered as higher performance operations within their respective districts:

Case study 1:	Irrigated owner/operator 112 ha dairy farm running 2.7 cows/ha on stony terrace soils near Dannevirke.
Case study 2:	High rainfall (1,865 mm) 188 ha dairy farm near Hukanui running 2.2 - 2.9 cows/ha under a 50:50 sharemilker agreement.
Case study 3:	Rain-fed 611 ha corporate research farm in the sand country near Parewanui, running dairy at 3.2 cows/ha and drystock at 14.7 su/ha.
Case study 4:	Hill country sheep and beef farm near Pahiatua running 9.5 su/ha.
Case study 5:	Proposed 264 ha easy hill dairy conversion looking to run 2.7 cows/ha, located near Pahiatua.
Case study 6:	Irrigated 778 ha mixed enterprise agribusiness running dairy (2.6 cows/ha), cropping (17 tn/ha maize grain/yr), and sheep/beef (8.1 su/ha), located near Marton.



Map 1. Location of case study farms and priority water management zones

41. Case study 4 is not located within a *priority water management zone*, nor does it qualify as 'intensive' under rule 13-1 (ie. not irrigated). It was included to test the implications of N-loss limits for an intensively operated sheep and beef hill-country farm.

42. Land Use Capability (LUC) was mapped for each property at detailed scales (1:3,000 to 1:10,000) according to national and regional standards (Fletcher 1987, MoW, 1969, Noble 1985, Page 1995). Regional 1:50,000 scale LUC was extracted from the New Zealand Land Resource Inventory (NZLRI) database (NWASCO 1975-79). Both were used to calculate farm N-leaching loss limits according to four five-year implementation periods as specified in the FARMS Workbook (HRC 2007), and results were compared to assess the effect of scale. Full method and results are reported on pages 39 to 46 of Manderson & Mackay (2008).

43. Farm N-leaching losses were estimated using OVERSEER (release 5.2.6.0) with production inputs obtained by farmer interview, and where possible from farm accounts and fertiliser receipts (provided by consultants). Environmental variables were extracted from consistent sources (eg. rainfall from HRC databases), assessed or verified through farm survey (eg. soil parameters), or objectively determined using Geographic Information Systems (GIS) (eg. effective grazed area). Nutrient models were constructed for the following year, based on inputs and performance from the previous year in most cases. Nutrient budget parameters, assumptions and outputs are detailed by case study (see Appendices 7.15 to 7.20, pages 102 to 112 in Manderson & Mackay 2008).

44. OVERSEER 5.2.6.0 assumes best practice regarding effluent treatment and application, stock yard runoff, fertiliser application, silage storage, and stock exclusion from waterways. Several cases were not using best practice for these activities. Conservative N-loss estimates using auxiliary calculations based on published results were made to demonstrate the implications of adopting best practice (see Appendix 7.9 page 80 in Manderson & Mackay 2008 for full calculations used in Case study 1).

45. Farm N-leaching losses were compared against farm N-loss limits, and OVERSEER phosphorus (P) loss risks were reported. A comprehensive list of options for mitigating N, P and faecal contaminants was compiled. Most promising options were nominated for each farm according to likely effectiveness, potential cost, magnitude of N-loss reduction, and farmer acceptability. Potential effectiveness and cost of promising mitigations were then evaluated. Existing best practice was recognised; including an

assessment of Clean Streams Accord status for dairy case studies (please refer to Appendices 7.15, 7.16, 7.17 and 7.20 in Manderson & Mackay 2008 for examples).

46. All other compliance requirements and specifications listed in the FARMS Workbook were assessed by site visit and supplemented by interviewing the farm owner, manager, farm staff, and farm consultant. Recommendations to achieve full Workbook compliance (including mitigations to achieve N-cap targets) were built into a five year strategy as objectives, with recommended activities and costs outlined by year.

47. Cost estimates for preparing a FARM Strategy are presented according to *Minimum*, *Medium*, and *Comprehensive* level options. Costs were based on case study preparation costs, and supplementary estimates provided by consultants. Full descriptions of each level are reported on pages 33 to 37 of Manderson & Mackay (2008).

48. Implementation costs were estimated according to capital costs (eg. riparian fencing), variable costs (eg. fertiliser), and immediate revenue implications associated with positive or negative changes in production (eg. reduced fertiliser costs through more effective effluent systems). Estimates were based on local prices provided by consultants at the time of FARM Strategy preparation. **Costs directly attributable to implementing a new FARM Strategy were differentiated from existing compliance costs.** Existing compliance costs relate to the Clean Streams Accord (predates the One Plan and FARMS) and existing resource consents granted before One Plan notification.

49. Additional expertise was consulted throughout, particularly from David Wheeler (AgResearch scientist and principal architect of the OVERSEER model), Ross Monaghan (AgResearch scientist and specialist in farm best management practice), along with policy consultation with Phillip Percy (resource management planner, Perception Planning) and Horizons Regional Council (Helen Marr, Jon Roygard and Peter Taylor). Fonterra was also engaged in an attempt to clarify Clean Streams Accord specifications.

50. Specialist expertise was contracted to more fully investigate situations posed by the uniqueness of individual farming operations, including effluent system analysis (Dr Dave Horne, Massey University), engineering advice (Wai Waste Environmental Consultants), LUC survey and classification (LandVision), and a range of agribusiness consultants were contracted for feed budgeting, production assessments, and the provision of local cost estimates (DairyTeam, Tararua Veterinary Services, Sheppard Agriculture, and

Baker & Associates). James Hanley (research associate and OVERSEER expert, Massey University) was contracted to formally check and critique nutrient modelling for the first case study farm. Most supplementary assessments are reported in Manderson & Mackay (2008) as Appendices 7.3 and 7.4 (dairy effluent disposal assessments), Appendix 7.14 (dairy conversion analysis), or they have been integrated into individual case study reports (Appendices 7.15 to 7.20).

Results and key findings from the FARMS test farms project

51. The following statements apply only to the six case studies unless otherwise indicated. Individual summaries for each case study are provided in this evidence as Appendix 1. Full results and discussion are available in Manderson & Mackay (2008) both as detailed case study reports (Appendices 7.15 to 7.20) and as a summary report (pages 9 to 31).

52. **Farm N-loss limits were moderately high in most cases**. The highest achievable N-cap is 32 kg N/ha/yr (ie. a farm with all LUC Class I land). The majority of case studies fell within a 20 to 25 kg N/ha/yr range, decreasing proportionally over the 20 year implementation period (Table 1).

53. The exceptions were cases 4 and 5, which were notably lower at 11 kg N/ha/yr. Both represented easy rolling hill country that was classified as LUC Classes 4 and 6 using the LUC standards then available (MoW 1969). Under the new standards, (Lynn et al. 2009) much of the Class 6 land would be more correctly classified as LUC Class 5, potentially improving the farm N-loss limits by 0.6 and 1.9 kg N/ha/yr for cases 4 and 5 respectively.

Table 1. Case study N-loss limits for the 20-year implementation period

	Farm N-loss limits (kg N/ha/yr)			
	Year 1	Year 5	Year 10	Year 20
Case study 1 (Dannevirke dairy)	24	21	19	18
Case study 2 (Hukanui dairy)	20	19	17	16
Case study 3 (Sand country mixed)	24	21	20	19
Case study 4 (Pahiatua sheep/beef)	11	11	10	10
Case study 5 (Dairy conversion)	11	11	10	10
Case study 6 (Marton mixed)	25	22	20	20

54. New LUC Class 5 standards may have implications for the calculation of N-loss limits on a catchment basis. The degree of implication will depend on how much LUC 6e land is now eligible for reclassification as LUC 5e land within the Horizons Region. This will not be known until the regional LUC correlation currently being undertaken by Landcare Research is complete.

55. **Most intensive farms in the Region are expected to have similar N-loss limits**. The average percentage area distribution of LUC classes for the case studies is similar to an estimated regional average (Table 2), whereby the regional average is calculated using LUC from the NZLRI database clipped to dairy, cropping and vegetable farms recorded in HRC's version of the Agribase database. The average for LUC 6 is skewed by inclusion of case study 4 (hill country), which does not actually qualify as an intensive farm under Rule 13-1 (see Paragraph 42).

Table 2. Percentage area of LUC classes found on each case study farm compared against an estimated regional average

	LUC 1	LUC 2	LUC 3	LUC 4	LUC 5	LUC 6	LUC 7	LUC 8
Case study 1		46%	38%	3%	1%	2%	4%	6%
Case study 2		24%	29%	34%	1%	11%	1%	
Case study 3	24%	32%	13%	16%		15%		
Case study 4		1%	9%	8%		71%		
Case study 5			17%	12%		71%		
Case study 6	36%	27%	16%	8%		9%	1%	3%
Case study average	**12%**	**26%**	**24%**	**16%**	**<1%**	**36%**	**1%**	**2%**
Regional average	**6%**	**37%**	**26%**	**9%**	**<1%**	**17%**	**4%**	**1%**

56. **OVERSEER N-leaching losses were lower than expected**. In particular, dairy N-leaching losses were notably lower than the 'average farm values' reported in OVERSEER (Table 3 & 5). However, case study results were well within the ranges reported by Clothier et al. (2007).

Table 3. N-leaching loss ranges by farming type

	Case study N-leaching ranges		Reported N-leaching ranges	
	N-leaching range by whole farm	N-leaching range by farm enterprise	Average ranges reported in OVERSEER	Ranges reported in Clothier et al. 2007
Cropping	-	24	-	10-140 kg N/ha
Dairying	15-26	15-26	30-50 kg N/ha	15-115 kg N/ha
Sheep and beef	10	10-11	5-20 kg N/ha	6-60 kg N/ha

57. Reasons for lower than expected N-leaching losses relate to the averaging of losses across the whole farm, existing good farming practice, and the level of investigation directed at each farm.

58. Workbook N-leaching reference values were calculated using total catchment area (Clothier *et al*., 2007 Appendix 6) rather than effective grazing area. It follows that total farm area should be used to calculate OVERSEER N-leaching losses (and farm N-loss limits). This is not always standard industry practice, nor is effective area always measured. All of the case studies had significant areas of non-grazed land measured by GIS mapping (Table 4) that effectively diluted whole farm N-leaching losses (in some cases by 4 kg N/ha/yr).

Table 4. Effective areas of case study farms

	Total area (ha)	**Non-pasture (ha)**	**Pasture (ha)**	**Effective %**
Case study 1	112	18	94	84%
Case study 2	188	22	166	88%
Case study 3	611	146	465	76%
Case study 4	973	88	885	91%
Case study 5	264	21	243	92%
Case study 6	778	182	596	77%

59. Similarly, two of the intensive cases had large areas that were used for less intensive purposes. These areas attracted far lower N-leaching losses, which averaged out the higher leaching losses of the more intensive areas. For example, 34 kg N/ha/yr leaching for the dairy platform of case study 3 decreased whole farm leaching loss down to 18 kg N/ha/yr when the support block was included.

60. In most cases the farmers were managing their N-inputs efficiently (eg. low N-fertiliser rates and split dressings), and several already had significant N-mitigation practices in place (eg. the regular use of N-inhibitors, feeding maize silage).

61. **N-cap balances varied from -6 kg N/ha/yr in deficit, through to +9 kg N/ha/yr in credit** (Table 5). Cases in deficit need to reduce N-leaching losses to achieve compliance, while those in credit do not need to take any related actions. The two properties with support blocks had the highest N-credits (+6 and +9 kg N/ha), and could conceivably trade these if a nutrient trading programme was established.

62. **Farming within N-loss limits is achievable for all the case studies**. All the farms had a range of N-mitigation options available, which were assessed in terms of relevance to the specific farm (example as Appendix 2). Most promising options were evaluated further in terms of potential effectiveness and likely cost (see individual case summaries, Appendix 1). Assuming full compliance with other obligations (see Paragraph 69) then only one or two additional mitigations would need to be adopted by those cases with an N-balance deficit.

63. **No major farming changes, such as reduced stocking rates, would be required to achieve N-cap targets**. Fulfilling existing obligations would go along way towards meeting targets (see Paragraph 69). The balance could be readily achieved by adjusting management inputs and adopting best practice in all cases. Recommended options included N-inhibitors (1 case), larger effluent disposal areas (3 cases), and using high-energy supplement (2 cases).

Table 5. Summary of case study N- loss limits, N-leaching losses, and N-cap balances

	Farm N-loss limits (kg N/ha/yr)				**OVERSEER N-leaching** (kg N/ha/yr)	N-cap balances[a] (kg N/ha/yr)			
	Year 1	Year 5	Year 10	Year 20		**Year 1**	Year 5[b]	Year 10[b]	Year 20[b]
Case study 1 (Dannevirke dairy)	24	21	19	18	**25**	**-1**	-4	-6	-7
Case study 2 (Hukanui dairy)	20	19	17	16	**26**	**-6**	-7	-9	-10
Case study 3 (Sand country mixed)	24	21	20	19	**18**	**6**	3	2	1
Case study 4 (Pahiatua sheep/beef)	11	11	10	10	**10**	**1**	1	0	0
Case study 5 (Dairy conversion)	11	11	10	10	**15**	**-4**	-4	-5	-5
Case study 6 (Marton mixed)	25	22	20	20	**16**	**9**	6	4	4

Note (a) for Table 5: A red negative N-cap balance indicates the N-leaching reduction that is required to achieve compliance. A positive blue number indicates that the balance is in credit.

Note (b) for Table 5: N-cap balances for Years 5-20 are calculated on the assumption that N-leaching losses will remain unchanged over the 20-year implementation period. This cannot be reliability predicted over such a long timeframe. Current intensification trends may increase N-leaching, or conversely, the emergence of new technology may decrease N-leaching. Accordingly, longer term balances are presented for discussion purposes only,

64. **All case studies had a variety of additional N-mitigation options available should they be required for future consideration**. On the one hand this is positive – these farms have room to develop and intensify if needed. On the other, it suggests that voluntary uptake of best practices has not been fully effective, and that there is still considerable room for improvement. While several farms were already practicing some N-mitigation options, the reasons for doing so were often production orientated (eg. use of N-inhibitors firstly to improve pasture production).

65. Less mitigation options are available for lower intensity land uses, and the uptake of any given mitigation is likely to have comparatively less impact when N-leaching losses are initially low. Case study 4 (hill country sheep and beef farm) had less mitigation options available. Further, because leaching loss was already low (11 kg N/ha), adopting

mitigations had less proportional impact compared to adopting the same mitigation on a dairy farm.

66. **Twenty year N-cap targets would also be achievable, but more challenging**. Farm N-loss limits for the case study farms will decline by 9% to 25% over the 20-year implementation period. The rate of decline will be greatest for farms with higher capability land. For example, N-loss limits for case study 4 (sheep and beef) will decrease only 1 kg N/ha while case study 1 (dairy farm) will decrease by 6 kg N/ha. The second case could therefore find N-cap targets more challenging over the long term.

67. Assuming farm N-leaching remains constant, then the 'sinking lid' nature of N-loss limits means three of the case studies would need to adopt additional mitigations to remain compliant. Again, even at these slightly more challenging levels, N-cap targets are still likely to be achievable without having to make major farming changes or sacrifice stocking rates.

68. If N-leaching rates continue to match current intensification trends, then major farm system changes would be needed to remain compliant over the 20-year term. However, reliable predictions cannot be made over such long timeframes. Likewise, the emergence of new mitigation technologies and techniques may actually decrease long-term N-leaching.

69. **Most case studies could achieve their N-cap targets by fulfilling other obligations**. All dairy case studies were non-compliant with existing effluent discharge consents, particularly in regard to the volume of effluent produced, effluent storage problems and irrigator problems. By default, these properties were also non-compliant with the Clean Streams Accord. Further, all dairy cases required some degree of stock exclusion from appreciable streams or lakes, and the installation of bridges or culverts across regular crossings (also Accord requirements). Lastly, the Workbook contains several non-negotiable requirements that can have a direct bearing on N-leaching losses. The cumulative effect of fulfilling all these obligations would reduce N-leaching losses, up to as much as 3 kg N/ha in one case (case study 2). The consequence is that less extra mitigations need to be adopted to achieve N-cap targets.

70. **All cases needed further work to achieve full compliance with other FARMS Workbook requirements**. The Workbook has approximately 50 requirements other than those relating directly to N-cap targets (covering effluent, dumps and offal holes, fertiliser, faecal contamination, feed supplements, sewages and sludge, and water

takes). Intensive farms that were more developed tended to require less work to meet these requirements. For example, most of the dairy cases already had a degree of stream fencing, culverts, feed storage, and reticulated water to almost all paddocks. The sheep and beef property had relatively less developments spread over a greater area, and would therefore require more work before Workbook requirements could be achieved.

71. If the intensively operated sheep and beef farm (case study 4) qualified under Rule 13-1, then the strict application of Workbook requirements <u>to the whole farm</u> would result in an unreasonable set of compliance targets (Table 6), such as 40 km of stream fencing, 45 new troughs, 28 new culverts and the construction of 18 new dams. If Workbook requirements were applied only to the most intensively used part of the farm, then the set of compliance targets dropped to an achievable level (Table 6) (this analysis is included as Appendix 7.10 on page 83 of Manderson & Mackay 2008). It is important to reiterate that case study 4 was included to explore the implications of Rule 13-1 for intensive sheep and beef farming, but the farm itself is exempt (see paragraph 42).

72. Similar higher compliance cost situations were encountered with cases that had extensively farmed blocks supporting the main intensive block. Support blocks tended to be less developed, and therefore required more work to meet compliance requirements.

73. **Having to farm within N-loss limits has only minor financial implications**. The default cost of implementing mitigations to achieve N-loss limits was nil in all cases except one (Table 6). Most costs were accommodated by having to fulfil other obligations (see Paragraph 69). The exception was the dairy conversion, where the recommendations were to adopt N-inhibitors and purchase Triticale silage rather than growing it on farm. Both recommendations were solely related to N-cap targets. Combined cost was high at $98,200 but this would be offset by production gains of at least $71,200 assuming a conservative inhibitor response (7.5%).

Table 6. Summary of recommended actions and estimated costs for compliance

	Recommendations and requirements to achieve compliance [a]	Financial implications [e]			
		Clean Streams Accord costs [a]	Other FARMS Work-book costs [a]	Default N-cap costs [a]	Revenue implications[a]
Case study 1 (Dannevirke dairy)	- Enlarge effluent area - Fence waterways (3.2 km) - Install 2 culverts - Control pond overflow (redirect storm water) - Install two troughs - *Construct bridge* [b] - Move dump site	$24,600	*$74,500*[b]	$0	$2,860 loss from land retired by fencing waterways
Case study 2 (Hukanui dairy)	- Larger effluent area + improved fertiliser + less urea + more supplement - Upgrade effluent system - Fence waterways (3.1 km) - Install three culverts - Divert shed roof storm-water to land	$61,610	$500	$0	Net saving of $3,300/yr $6,400 loss from land retired by fencing waterways
Case study 3 (Sand country mixed)	- Install effluent holding pond for existing consent compliance - Fence lakes (1 km) - Deactivate use of stock ford - *Construct two silage bunkers* [c]	$3875	*$180,000*[g]	$0	$1,060 loss from land retired by fencing lakes
Case study 4 (Pahiatua sheep/beef)	- *Control yard discharge (wetland)* [h] - Fence waterways (*40 km* or 11 km) [d] - New troughs (*45* or 35 units) [d] - New culverts (*28* or 21 units) [d] - Dams (*18* or 2) [d] - Move offal hole site	na	*$455,175*[d] ($50,710)	$0	$6,000 loss from land retired by fencing waterways
Case study 5 (Dairy conversion)	As a new conversion, both Accord and One Plan compliance is assumed by default for all requirements other than farming within N-limits - Adopt N-inhibitors - Purchasing Triticale silage rather than growing it on-farm	$0	$0	$98,200[f]	Plus $71,200 gain. 7.5% inhibitor response to break even [f]
Case study 6 (Marton mixed)	- Control storm-water - Fence waterways [g] (*3.7 km* or 2.8 km) - Cease use of stock fords	$16,680	*$19,400 - $29,080*	$0	$370/yr loss from land retired by riparian fencing

	Recommendations and requirements to achieve compliance [a]	Financial implications [e]			
		Clean Streams Accord costs [a]	Other FARMS Work-book costs [a]	Default N-cap costs [a]	Revenue implications[a]
	- Relocate offal hole - Decommission dump - *Manage sheepyard effluent* [h] - Enlarge dairy effluent area; improve washdown practice; install effluent holding pond				Plus $12,000/yr gain from improved nutrient use

[a] Blue = Clean Streams Accord obligation, Red = One Plan non-negotiable requirement, Green = Additional recommendations to achieve Year 1 N-target. *Items and costs in italics are contestable.*

[b] Marginal as to whether the bridge ($73,000 cost) is a Clean Streams obligation or a One Plan requirement.

[c] One Plan specifications need clarification. Shifting to smaller stacks is a possible loophole but N-leaching would remain unchanged.

[d] Number of units dependent on whether the whole farm, or just the intensive proportion, qualifies for compliance considerations.

[e] Owing to volatility in payouts and input prices, estimated costs are only relevant to when each particular case study was prepared.

[f] In all cases where N-inhibitors were recommended for achieving N-targets, the cost of inhibitor is likely to be offset by production gains. Only modest responses were required to break even (6% to 7.5%). Higher response rates could be expected for some of the cases.

[g] Includes optional recommendation to fence a 'suspect' stream (0.9 km @ $4,680), which has all the bed characteristics of a sizeable stream but when examined (early winter 2008) the stream was effectively dry (ie. technically it does not qualify as a targeted stream).

[h] Requires clarification from the council regarding the intended applicability of effluent discharge requirements to sheep yards.

[i] Represents a worst case application of FARMS. The property does not actually qualify as 'intensive' under the One Plan.

74. **Other Workbook requirements (ie. those not directly related to N-loss limits) represented the single largest cost in most cases.** Often a single compliance item incurred a major and somewhat disproportionate cost. For example, the $73,000 cost of installing a bridge for case study 1 was disproportionately high against other compliance costs of $1,500. However, several of the large ticket costs (bridges, silage bunkers, treating effluent from non-dairy stock yards) were considered contestable because of ambiguity or inconsistencies either within, or between, both the FARMS Workbook and the One Plan.

75. **Total cost of FARMS compliance could be minor or major depending on contestable items**. If farmers successfully contest large ticket compliance items, then FARMS implementation costs would generally be small (Table 7). All the large ticket items are contestable, and I am of the opinion that good arguments could be put forward against requiring these investments. The bridge in case study 1 is a little different, in that contestability arises because it is borderline if the requirement (and cost) falls under Clean Stream Streams Accord obligations (bridging *regular* crossings) or FARMS requirements (bridging all crossings).

76. FARMS costs for case study 6 (Table 7) are elevated because the farmer nominated to include his support block in the compliance assessment. Similarly, case study 4 costs are high because the farm was included as an extreme example.

Table 7. Summary of FARMS implementation costs under best and worse case scenarios (excludes Clean Streams Accord costs)

	FARMS implementation cost		
	Best case	**Worse case**	**Contestable items and comments**
Case study 1	$1,500	$74,500	Bridge ($73,000)
Case study 2	$1,560	-	-
Case study 3	$0	$180,000	Two large silage bunkers ($180,000)
Case study 4	$50,710	$455,175	(depends on how the farm is assessed)
Case study 5	$0	$27,700	(depends on N-response)
Case study 6	$14,400	$29,220	Sheepyard effluent system ($10,000), some stream fencing ($4,820)

77. FARM Strategy preparation costs were estimated at $1,500 for a *minimum* level, between $2,300 and $5,000 for a *medium* level, and potentially more than $10,000 for a *comprehensive* level Strategy. Minimum level strategies are likely to suffice in most cases, with medium and comprehensive levels retained for complicated or challenged farm operations that require in-depth analysis and expert input.

78. **The scale of LUC mapping could influence the calculation of farm N-loss limits**. However, results were variable (Table 8). Farm-scale mapping could result in better or worst N-loss limits depending on landscape characteristics.

Table 8. Summary of N-loss limits calculated at different scales

	Regional scale mapping	Farm scale mapping	Implications
Case study 1	26	24	Worsens N-cap (-2 kg N/ha)
Case study 2	23	20	Worsens N-cap (-3 kg N/ha)
Case study 3	25	24	Worsens N-cap (-1 kg N/ha)
Case study 4	10	11	Improves N-cap (+1kg N/ha)
Case study 5	12	13	Improves N-cap (+1 kg N/ha)
Case study 6	25	25	No change
Auxiliary case	14	18	Improves N-cap (+4 kg N/ha)

Recommendations for the refinement of the FARMS framework

79. **Redesign the FARMS Workbook.** The modular design of the Workbook proved difficult to use, was considered too lengthy by farmers and consultants, and having to reference back and forth was inefficient. Further, the current design does not request the depth of information needed for the resource consent process.

80. **Improve Workbook definitions, specifications and the wording of requirements.** There were discrepancies between the Workbook and One Plan specifications. For example, Workbook effluent separation distances of 200 metres were considerably larger than 20 metres specified in the One Plan. Further, there was ambiguity or insufficient definition for certain specifications, making interpretation difficult and contestable. A full list of recommended specification changes is made in the FARMS Test Farm Report (Manderson & Mackay 2008).

81. **Provision is made available to increase the capability of irrigated land by one full LUC class.** Some classes of land can respond dramatically to irrigation (eg. sand country), thereby improving land capability. Provision is available in existing standards to increase capability if the irrigation system can be considered permanent. Traditionally 'permanent irrigation' has only applied to large irrigation schemes in the South Island, but the recent revisions (Lynn et al. 2009) now recognise centre pivot systems. Other irrigation systems could be considered if they were deemed 'permanent' over the term of the resource consent. Any revised LUC classification should only apply to the contained area of irrigator spread, and should only be classified by qualified LUC surveyors.

82. **Contingencies should be developed for farms that straddle *priority water management zone* boundaries.** It is not clear if such farms are included under Rule

13-1. Similarly, it is not clear if the Rule applies to part of the farm (ie. the part within the *priority water management zone*), or the entire farming operation is eligible for inclusion. Likewise, implementation dates are unclear for farms that straddle two or more *priority water management zones*.

83. **Applicants should retain discretion over the inclusion of support blocks.** Including support blocks can decrease whole farm N-leaching values, thereby making N-cap targets more achievable. Conversely, support blocks can increase compliance requirements and costs, particularly when such blocks are relatively less developed. Further, less intensive blocks may result in an unreasonable set of compliance requirements (eg. case study 4). Discretion allows applicants to work out the best balance between N-cap achievability and compliance cost for their particular farming operation.

84. **Applicants should retain discretion over the scale of LUC mapping used to determine farm N-loss limits.** The effect of LUC mapping scale on N-loss limits was variable. Commissioning a farm-scale survey may result in better or worse N-loss limits. It is therefore recommended that applicants retain the right to choose which scale of mapping is used to calculate N-limits.

Recommended protocols for nutrient budgeting within the FARMS framework

85. There is a risk that OVERSEER can be incorrectly used to represent farm N-leaching losses. To avoid misuse and encourage consistent modelling, a suite of assurance protocols was recommended.

86. **Standardise OVERSEER inputs using consistent information sources where possible.** Annual rainfall is a key input variable that affects N-leaching. Sources of rainfall information are many, and can vary in quality from local 'best guess estimates', through to quality long-term averages supplied by weather recording organisations. If HRC can make available farm rainfall averages extracted from one consistent database, then this would manage one source of potential modelling variation (methodology for regionally consistent rainfall information is described in Jon Roygard's evidence). There may be other input variables suitable for consideration (eg. distance from coast).

87. **Only accredited OVERSEER operators should undertake nutrient budgeting for FARMS.** Operators who have achieved accreditation through Massey University's Sustainable Nutrient Management courses (intermediate or advanced) are trained in the

correct use of OVERSEER, including how to build a representative model, limitations to watch out for, and the selection and evaluation of effective mitigation options.

88. **Use accurate measures of farm area.** Reliable area information (determined from field measurement, planar measurement within a GIS, or GPS measurement) is not always commonplace. Only one case study farmer had a recent paddock map with fair estimates of effective grazed area, and a good representation of total farmed area (including a substantial area of river land that was not owned, but was regularly used in the grazing rotation). Other cases relied on a range of old and largely inaccurate maps, including a hand-drafted subdivision map with guessed paddock areas. Similarly, effective grazing areas were generally 'best guess estimates'. Total farm area, effective grazed area, and the area of nutrient management blocks, all influence the N-leaching loss number calculated by OVERSEER.

89. **Require justification for changes to default OVERSEER settings.** Certain OVERSEER variables are set to default settings, and should only be adjusted by qualified operators who understand the modelling implications of such a change. Requiring operators to maintain default settings ensures consistent modelling. However, when better information is available (ie. better than the default setting) and there is sufficient reason to make the change, then it is recommended that operators be required to list and transparently justify why they changed the default values (see Information Check below).

90. **FARM Strategies include an *Information Check* as an appendix.** Information Checks were prepared for all six case studies as a means to improve model transparency. Each Information check listed all OVERSEER inputs, assumptions, and justification for any change to default settings. Sufficient detail was provided to rebuild the nutrient model from the Information Check alone. Both the farmer and the consultant who undertook the modelling were expected to sign the Information Check as being true and correct.

91. **FARM Strategies include OVERSEER output tables for checking.** Output tables perhaps provide too much detail for the resource consent process. However, they do provide a degree of confirmation of N-leaching loss, and those who can interpret such tables may be able to identify modelling discrepancies.

92. The Council may also consider encouraging the regular monitoring and recording of farm management activities that have a direct bearing on the calculation of OVERSEER

N-leaching, such as fertiliser and effluent application (when, where and how much). Such information would improve the representativeness of successive nutrient budgets. Ongoing monitoring and recording could even be considered as a condition of the FARMS resource consent.

93. If tighter assurances with OVERSEER modelling are required, a random auditing system can be introduced.

The revised FARMS Workbook and combined resource consent application form

94. AgResearch was further contracted in March 2009 to review and update the content and structure of the FARM Strategy Workbook. Project objectives included:

i. Integrate recommendations made in the FARMS test farms report (Manderson & Mackay 2008).
ii. Improve Workbook useability for applicants.
iii. Work with HRC staff to improve Workbook applicability to the resource consent process.

95. There have been three FARMS Workbook versions so far:

i. Version 1: Original FARM Strategy Workbook (HRC 2007).
ii. Version 2: Planning checklist and supporting guidebook (not released).
iii. Version 3: Integrated workbook and resource consent application form (please refer to Appendix 3).

96. The first version was orientated towards modular-based planning, whereby farmers would develop a strategic plan outlining how they would work towards a compliance status over the interim period before rule 13-1 comes into effect (ie. before *priority water management zone* implementation dates). This is how the six FARMS test farms strategies were developed.

97. The second version moved away from the modular design, and more towards a checklist worksheet and supporting guidebook. Users work their way through the compliance checklist, making reference to explanations in the guidebook if needed. This approach is suitable for both new users who need detailed explanations, through to regular users (eg. consultants) who can assess farm compliance quickly as they become more versed in guidebook specifications.

98. The third version seeks to integrate FARMS planning with the resource consent process (referred to as the FARMS Workbook 3). Effectively the broadness of FARMS planning had to be fitted within the regulatory confines of the resource consent framework.

99. HRC specified that they would like to improve the Workbook's ease of use, whereby farmers can develop their own FARMS resource consent applications without a default reliance on consultants. However, the resource consent process is not renowned as being user-friendly, and can be demanding in terms of the type and rigour of information that must be supplied. This was of special concern because of the number of regulated activities covered by FARMS (far more than the conventional 'one activity requires one consent' approach), which could result in FARMS becoming a very demanding and difficult process.

100. An acceptable level of trade-off between ease of use and rigour was modelled from the Inland Revenue Department. Single income tax returns are designed to be completed by individuals, but manage to make an otherwise specialist accounting process accessible to anyone with basic algebra skills. While few may enjoy the process, the simple tax return achieves a high standard of rigour that is accepted by authorities, and it can be completed by individuals without requiring outside help.

101. The revised FARMS Workbook 3 (Manderson 2009b) has two components – a *FARM Strategy Consent Application* form and a supporting *FARMS Reference Guide*.

102. The Farm Strategy Consent Application form requests information according to twelve sections:

i. **Applicant information.** Standard information requested for non-notified resource consent.
ii. **Property details.** Standard application information revised slightly to request information relevant to Rule 13-1.
iii. **Farm maps.** Applicants are requested to supply a farm LUC map and a property map that depicts features of relevance to Rule 13-1.
iv. **Calculate farm N-caps.** Stepwise calculations are provided for working out N-loss limits for the farm.
v. **Assess current N-leaching.** Instructions for obtaining OVERSEER N-leaching losses, and the calculation of the farm's N-cap balance.
vi. **Managing N-cap deficits.** Instructions for identifying and evaluating N-mitigations if the N-cap balance is in deficit.
vii. **Attach OVERSEER reports.**

viii. **Compliance status checklist.** Applicants are asked to evaluate their farm's Rule 13-1 compliance status using a checklist. This can be used as a planning tool to identify items that need attention, or as an affirmation that compliance is being achieved.

ix. **Supplementary information for farm effluent.** Additional information to process consents that require effluent management.

x. **Supplementary information for minor water takes.**

xi. **Supplementary information for major water takes.**

xii. **Final details.** Attachments, fees and signatures.

103. Each request for information is matched by a descriptive instruction in the FARMS Reference Guide. This may include an explanation of the requirement, a clarification of what is required (including definitions of terms), suggestions for obtaining certain types of information, and calculations for estimating water takes and effluent generation.

104. Development has involved close liaison with Horizons staff, and the circulation of several draft iterations to ensure the design and wording conforms to council resource consent requirements.

105. Drafts have also been circulated to independent professionals that have previously prepared FARM Strategies. Feedback has been positive, particularly around making the consent application process more accessible and transparent.

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APPENDIX 1: CASE STUDY SUMMARY REPORTS

Case study #1: Irrigated Dannevirke dairy farm

Description: Irrigated owner-operator 112 ha dairy farm located near Dannevirke, with 2.7 cows/ha yielding ~400 kg MS/cow (above local average) under moderate rainfall (1200 mm). Older river-terrace land with high capability (loess and old alluvial soils).

Contaminant assessment: Current N-leaching estimated at 25 kg N/ha/yr (OVERSEER® N-loss of 30 kg N/ha/yr was adjusted to reflect use of N-inhibitors and contributions to unfenced streams). P-loss risk to water assessed as LOW.

One Plan N-loss limits: Calculated at 24 kg N/ha/yr for 2011, and gradually decreasing to 18 kg N/ha over twenty-years. Current N-loss is 1 kg N/ha/yr above the 2011 N-limit (in deficit).

Mitigation options: Seven promising options were identified and evaluated. Options recommended to the farmer included fencing waterways, install culverts, construct bridge, and enlarge the effluent area. These actions are sufficient to achieve N-loss targets for year 2011, and most are required anyway either under the Clean Streams Accord or other parts of the One Plan.

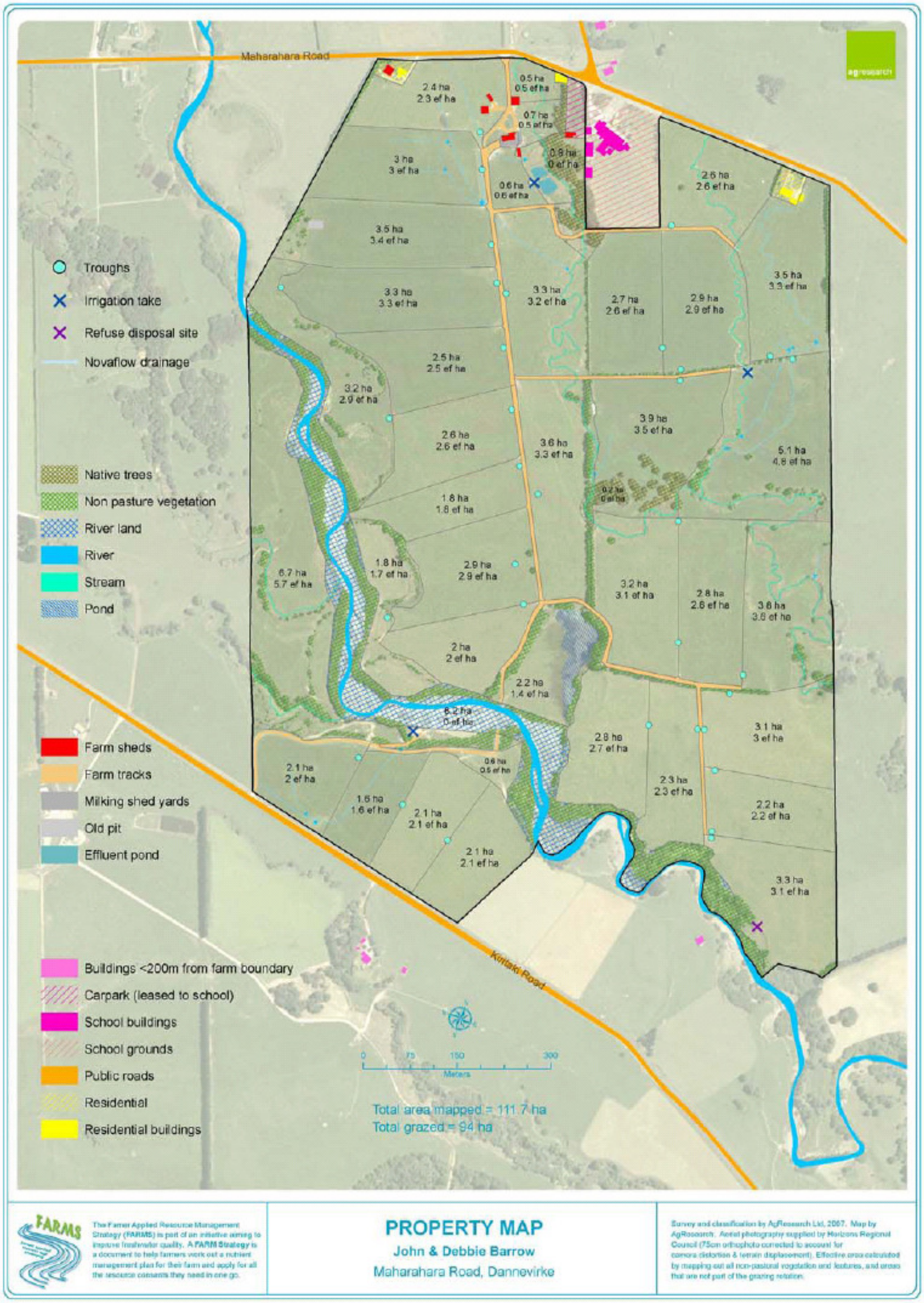
Option	Potential effectiveness	Economic implications	Practicality
High-E/low-N supplement	N-loss ↓ **2 kg N/ha/yr**	No appreciable change	High
Off-farm winter grazing	N-loss ↓ **9 kg N/ha/yr** & bug risk↓	Potential revenue increase of $7,000 to $13,000	High (but risky)
Enlarge effluent area 3ha	N-loss ↓	No appreciable change	High
Fence waterways	Bug risk↓ & N-loss ↓ **0.2 kg N/ha/yr**	$17,400 cost and $2,860/yr lost revenue	Low (required)
Planted riparian buffers	Bug risk↓ & N-loss risk↓	$10,000-$13,000 cost and $28,000 to $86,000/yr lost revenue	Extremely low
Construct bridge	Bug risk↓ & N-loss ↓ **0.6 kg N/ha/yr**	$73,000 cost	Low (required)
Install 2 culverts	Bug risk↓ & N-loss risk↓	$3,400 cost	High (required)

Compliance requirements: Items requiring attention include installing culverts, fencing streams, bridge construction, pond overflow, storm water discharge to ponds, farm dump location, and inadequate availability of trough water.

Compliance cost estimate: Total cost is estimated at $99,100. Bridge construction is the single most significant cost at $73,000. However, total cost reduces to $74,500 if Clean Stream Accord obligations are taken out ($24,600 for waterway protection), and would decrease further to only $1,500 if the bridge also qualified as a Clean Streams requirement (debatable).

Conclusion: This property will have no difficulty achieving One Plan N-targets. Fulfilling other compliance requirements will accommodate the necessary 1 kg N/ha/yr reduction, and there are many other mitigation options available to the farm going into the future. Compliance cost will be high at ~$73,000 (excluding Clean Streams obligations), the bulk of which would be incurred by having to construct a bridge.

FARMS development: Key issues identified with Case Study 1 include: a) Unknown N-inhibitor effectiveness, b) The importance of correct farm area information, c) Fertigation as a potential N-mitigation, d) Inconsistencies in Workbook and One Plan specifications, e) An unavoidable heavy-reliance on the farmer for information necessary for nutrient budgeting, f) N-loss sources and mitigation practice effects not accounted for in OVERSEER®, and g) Difficulties in the application of Clean Streams Accord definitions, particularly minimum dimensions for qualifying streams, and evaluating 'regular' crossings.



Map: Property map for Case Study #1

Case study #2: Rain-fed Hukanui dairy farm

Description: Rain-fed dairy farm (188 ha) located near Hukanui under higher rainfall (1865 mm), sharemilked with 2.2-2.9 cows/ha yielding ~375 kg MS/cow (above district average). Mostly high capability land (old river terraces) but also a sizeable area of low capability land (old Mangahao River bed).

Contaminant assessment: Current N-leaching estimated at 26 kg N/ha/yr (OVERSEER® N-loss of 23 kg N/ha/yr was adjusted to include contributions from unfenced water ways and an inefficient effluent system). P-loss risk to water assessed as LOW.

One Plan N-loss limits: Calculated at 20 kg N/ha/yr for 2010, and gradually decreasing to 16 kg N/ha over twenty-years. Current N-loss is 6 kg N/ha/yr above the 2010 N-limit (in deficit).

Mitigation options: Eight promising options were identified and evaluated. Options identified as being most suitable include fencing waterways, improved effluent system, and adopting N-inhibitors[1]. Taken together, these options would likely put farm N-loss balance in credit by 2 kg N/ha/yr for 2010. Two of the options are required under Clean Streams Accord obligations, while the other promises significant production gains. Adopting other available mitigations, plus making allowances for advances in technology, would mean longer term targets would be similarly achievable.

Option	Potential effectiveness	Economic implications	Practicality
N-inhibitors[4]	~~N-loss ↓ 5kg N/ha/yr~~	~~Only 6% yield response needed to break even; potentially considerably more profitable~~	~~High~~
Reduce urea 10%	N-loss ↓ **1kg N/ha/yr**	Modelled $22,750 reduction in gross revenue	Low
Reduce cows, supplement & urea scenario	N-loss ↓ **1kg N/ha/yr** & bug risk↓	Potentially +$50,000 in gross revenue but requires development investment (drainage, etc.)	Medium
Fence waterways	Bug risk↓ & N-loss ↓ **0.2kg N/ha/yr**	$11,200 cost and $6,400/yr lost revenue (gross)	Low (required)
Planted riparian buffers	Bug risk↓ & N-loss risk↓	$20,500-$23,700 cost and $33,800 to $42,300/yr lost gross revenue depending on buffer width (10-30m).	Extremely low
Travelling irrigator effluent system	Bug risk↓ & N-loss ↓ **1.6 kg N/ha/yr on average** (highly variable)	$31,500 cost (but would require pond capacity to double to be compliant) and requires high labour cost	Medium
Larall effluent system	Bug risk↓ & N-loss ↓ **1 kg N/ha/yr**	$49,360 cost (maybe less depending on pasture yield increases) but low labour costs	High
Wetland effluent system	Bug risk↓ & N-loss ↓ **0.9 kg N/ha/yr**	$15,000 cost	Low

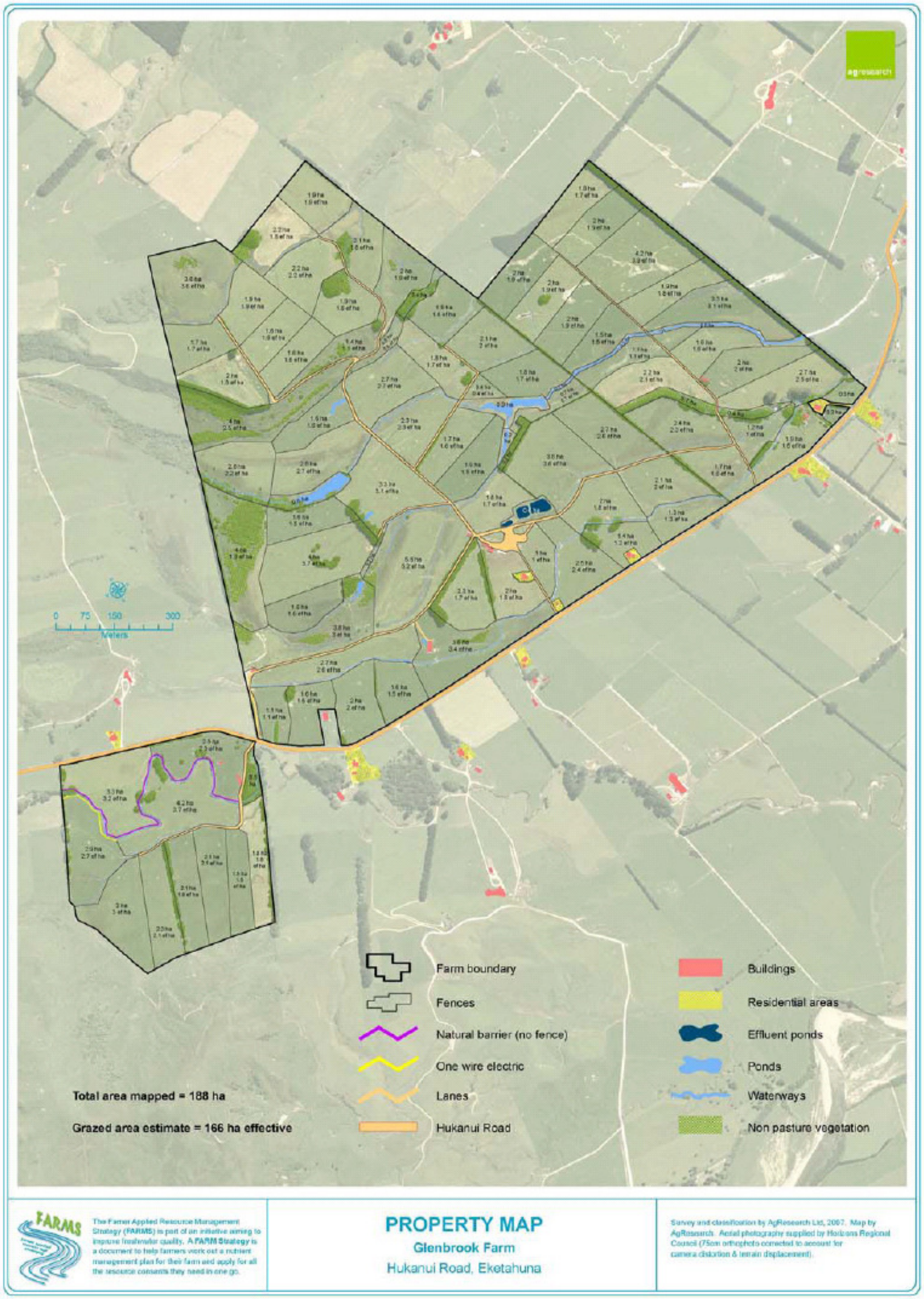
Compliance requirements: Fence waterways, upgrade effluent system, redirect milking-shed stormwater to land, install 3 culverts, and enlarge the effluent application area to 20 hectares.

Compliance cost estimate: Total cost is estimated at $62,120. However, upgrading the effluent system and fencing waterways can both be considered as Clean Streams Accord obligations ($60,560). Excluding Accord costs leaves $1,560 as the actual compliance cost.

Conclusion: This property should have little difficulty achieving One Plan N-targets, particularly after Clean Streams Accord obligations are fulfilled. Fencing waterways, upgrading the effluent system and adopting inhibitors[4] are sufficient to achieve the 6 kg N/ha/yr N-target for 2010, plus providing a 2 kg N/ha credit. Likewise, there are additional mitigation options available to the farm going into the future. Total cost is $62,120. However, $61,610 accounts for as Clean Streams costs. Actual cost of FARMS alone is estimated at $1,560.

FARMS development: Key issues identified include: a) An unavoidable heavy-reliance on the farmer for information necessary for nutrient budgeting, b) Conflict between information provided by the owner and the sharemilker, c) Nutrient modelling using information from the preceding year, when that particular year may not have been representative, and e) Effluent discharge-to-land system with extremely high leaching-loss risk but apparently compliant under the One Plan.

[1] N-inhibitors where later identified as being unsuitable for this property due to high drainage potential (~1300 mm). Alternative mitigation options were proposed and evaluated, including optimising fertiliser use, expanding the effluent area, and reduced urea use through high energy supplementation. N-leaching reductions were estimated at 3 kg N/ha (sufficient to achieve compliance), and money saved from reduced fertiliser use could result in a net saving of $3,300 each year. Accordingly, the key conclusions and final cost estimates remain largely unchanged.



Map: Property map for Case Study #2

Case study #3: Rain-fed corporate dairy and drystock farm

Description: Rain-fed corporate sand-country dairy farm with support block (611 ha) located near Parewanui with lower rainfall (900 mm). Dairy platform running 3.2 cows/ha and producing ~350 kg MS/cow (above local average). Extensive alluvial flats with high land capability.

Contaminant assessment: Current N-leaching is calculated at a modest 18 kg N/ha/yr. Relatively low N-loss is explained by the inclusion of large areas of redundant land, low producing land, and the support block, all of which average dairy N-loss across a greater area (N-loss for the dairy platform would be 32 kg N/ha/yr if these areas were excluded). P-loss risk to water assessed as LOW.

One Plan N-loss limits: Calculated at 24 kg N/ha/yr for 2014, and gradually decreasing to 19 kg N/ha over twenty-years. The farm is currently operating well within its N-loss limits, and no N-reductions or special mitigation practices are required. Indeed, the farm has a comfortable buffer extending out for the full 20 years of consideration.

Mitigation options: While no N-reductions are required, several mitigations were evaluated either for future reference, or because they are a requirement under a different part of the FARM Strategy workbook. Five options specific to this farm were evaluated.

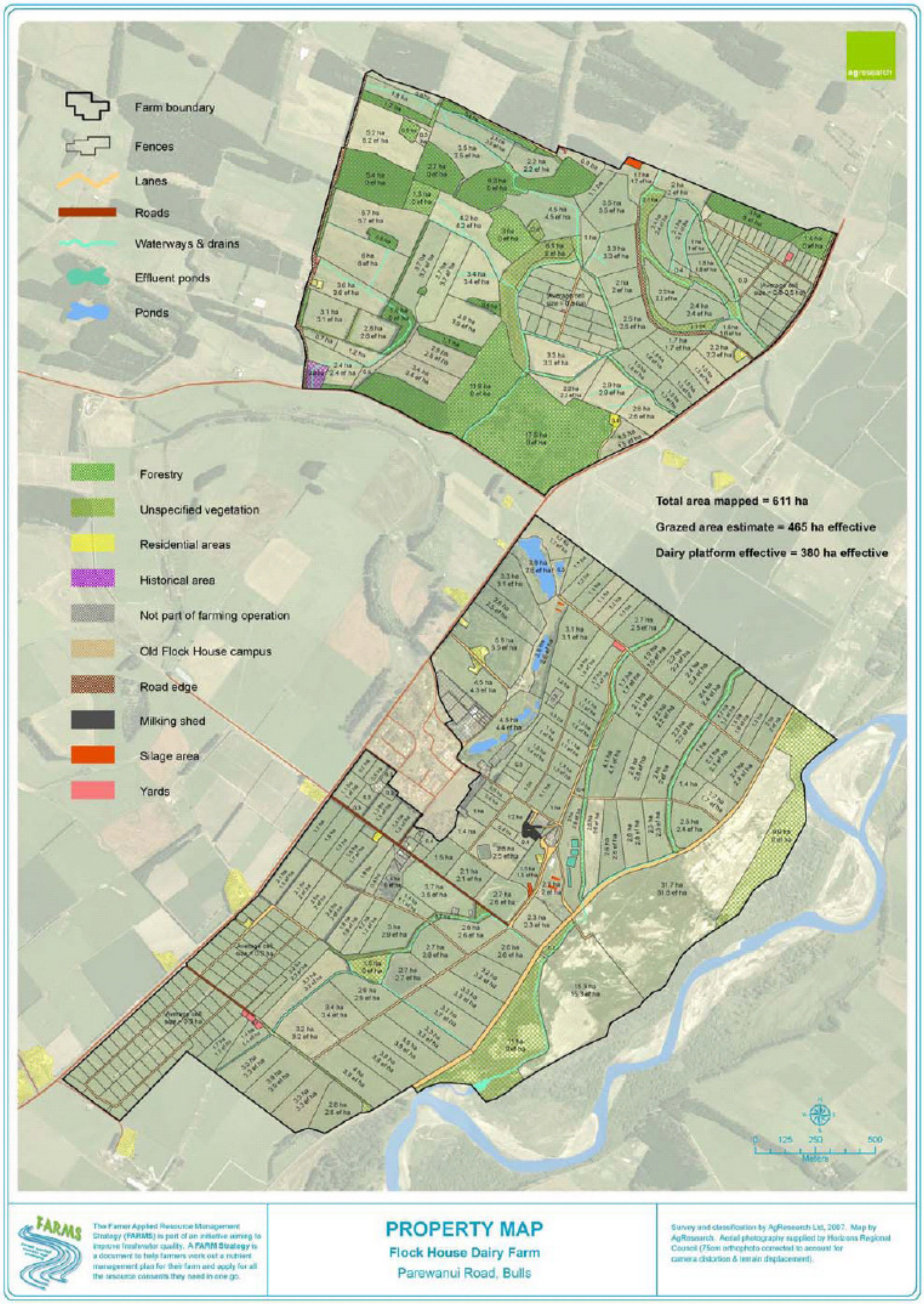
Option	Potential effectiveness	Economic implications	Practicality
N-inhibitors	N-loss ↓ **2.7 kg N/ha/yr**	Only 6.5% yield response needed to break even; potentially considerably more profitable	N-inhibitors
Stop use of urea in winter	N-loss ↓ **5 kg N/ha/yr**	Estimated $48,000 reduction in gross margin	Stop use of urea in winter
Install effluent holding pond	No impact with a small pond. Potentially N-loss ↓ **1 kg N/ha/yr** with a large pond	Small sealed pond recommended at a cost of $1,500	Install effluent holding pond (required)
Fence water bodies	Bug risk↓ & N-loss risk↓ & P-loss risk↓	$2,375 cost and $1,060/yr lost revenue (gross)	Fence water bodies (required)
New silage bunkers	N-loss potentially ↓ **0 - 3 kg N/ha/yr** (very tentative)	$180,000	New silage bunkers (required?)

Compliance requirements: Fence lakes, install effluent holding pond, and cease ford use by switching to alternative access to gravel block area. These are requirements under both the Clean Streams Accord and the One Plan. New silage bunkers may also be a requirement, depending on further clarification of both One Plan and the FARMS workbook specifications from the Council.

Compliance cost estimate: Assuming that two new silage bunkers are required, initial cost is estimated at $183,880. This reduces to $3,880 if having many smaller silage stacks (<500m^2) are permissible under the One Plan. Remaining cost is for waterway protection and effluent system improvement, both of which are Clean Streams obligations. Accordingly, the cost of FARMS may actually be nil.

Conclusion: Not only is this property operating well within its One Plan N-limits, but it has a comfortable buffer and several mitigation options to easily keep N-leaching within N-limits out to 2034 (assuming no radical changes). The farm has land with high capability, and dairy N-loss is being averaged across less intensively used areas. It is conceivable that FARMS compliance will incur no financial cost, but only if Clean Streams obligations are fulfilled, and switching to smaller silage stacks is clarified as being a permissible option under the One Plan.

FARMS development: Key issues identified with Case Study 3 include: a) Leachate losses from large-volume silage stacks not accounted for in OVERSEER®, b) Silage stack requirements are not clear in the One Plan, c) Required two separate OVERSEER® models (drystock and dairy), and d) A conceptual issue arose regarding the inclusion of runoffs or support blocks in the calculation of N-leaching losses (major averaging effect).



Map: Property map for Case Study #3

Case study #4: Rain-fed sheep and beef farm near Pahiatua

Description: Rain-fed sheep and beef farm (973 ha) near Pahiatua under moderate rainfall (1470 mm) and low to medium stocking rates (whole farm = 9.5 su/ha). Mostly low capability steepland, moderate capability hill country, and a small area of higher capability flats. The farm is not targeted as 'intensive' under Rule 13-1, and is therefore considered as an extreme example for achieving compliance.

Contaminant assessment: Current N-leaching is calculated at a 10 kg N/ha/yr. P-loss risk to water assessed as HIGH. Sediment loss was estimated by Landcare Research at 3,400 tn/yr.

One Plan N-loss limits: Calculated at 11 kg N/ha/yr for the first year, and gradually decreasing to 10 kg N/ha over twenty-years. The farm is currently operating within its N-loss limits, and no N-reductions or special mitigation practices would be required (if the farm qualified as being 'intensive').

Mitigation options: Several mitigations evaluated either for future reference, or because they are required by a different part of the FARM Strategy workbook. Eight options specific to this farm were evaluated.

Option	Potential effectiveness	Economic implications	Practicality
Urease-urea replacement	N-loss ↓ **1 kg N/ha/yr**	Cost of $8,000 but potentially offset by at least +$8,000 production gains	High
Wetland for yard runoff	Bug risk↓ & P-loss risk↓ & N-loss risk↓	$2,700 cost for fencing & planting	Medium (required)
Fence waterways	Bug risk↓ & P-loss risk↓ & N-loss risk↓	$400,000 for 40 km sheep-proof fencing	Low (required)
Planted riparian buffers	Bug risk↓ & P-loss risk↓ & N-loss risk↓	$405,200-$407,800 cost and $10,400 to $31,250/yr lost revenue	Extremely low
Install 28 new culverts	Bug risk↓ & P-loss risk↓ & N-loss risk↓	$15,000 cost	Low (required)
Install 45 new troughs	Bug risk↓ & P-loss risk↓ & N-loss risk↓	$19,475 cost	Low (required)
Construct 18 new dams	Bug risk↓ & P-loss risk↓ & N-loss risk↓	$18,000 cost	Low (required)
New bridge?	Bug risk↓ & P-loss risk↓ & N-loss risk↓	$20,000	?

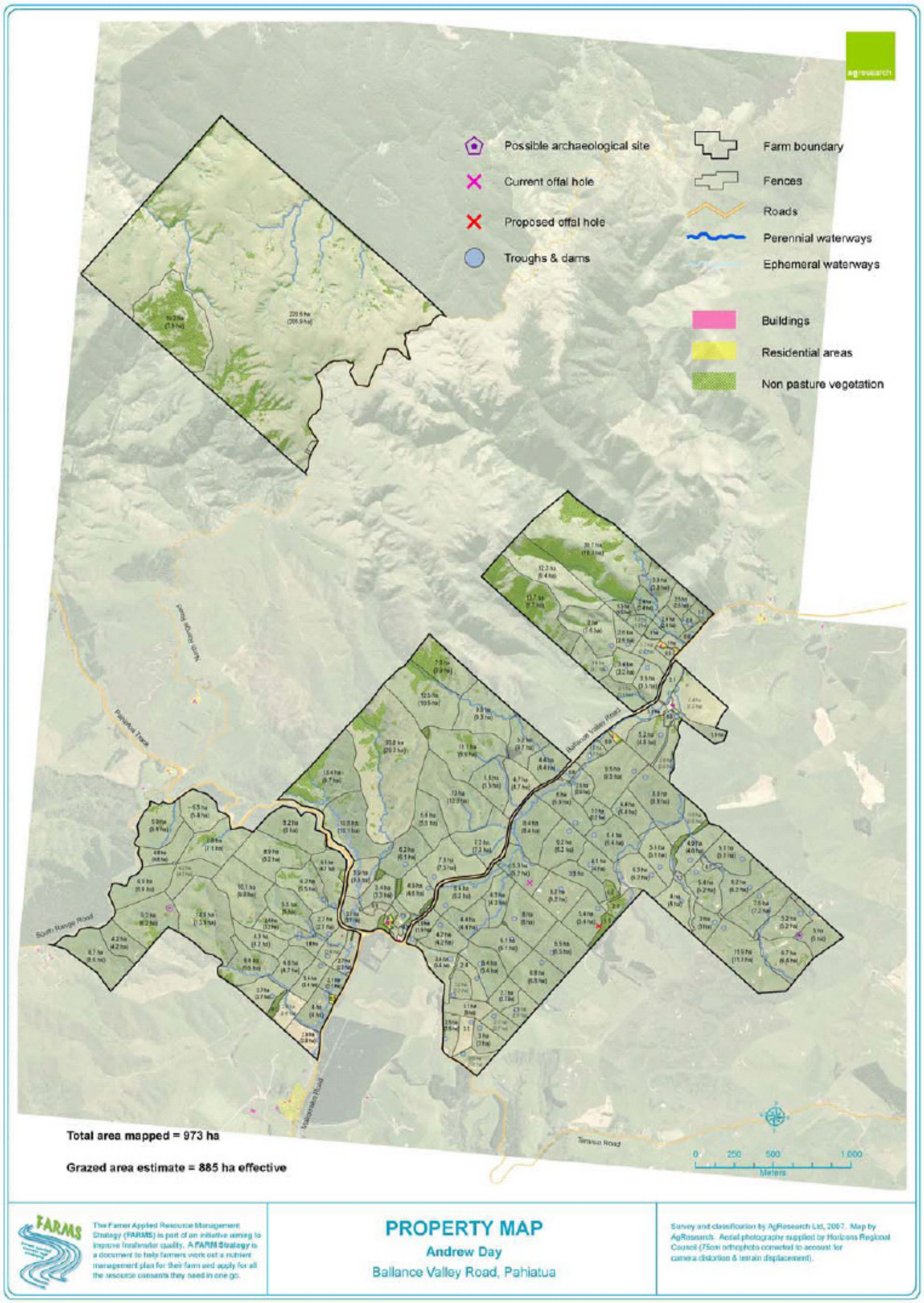
Compliance requirements: Includes 40 km of riparian fencing, controlling sheep yard effluent discharge, relocate offal hole, 28 new culverts, 18 dams, 45 troughs, and retire 3 ha isolated by stream fencing or construct a bridge. None of these requirements can be considered as Clean Streams Accord obligations.

Compliance cost estimate: Cost of full compliance is estimated at $455,000 or $475,000 if a new bridge is installed. The greatest cost arises from the waterway protection programme (including new fencing, culverts, dams, and troughs). This reflects the dissected landscape and related high incidence of waterways found in hill country, and in the Tararua District.

Reinterpretation of One Plan requirements: This case study is considered an extreme application of FARMS in being an 'extensive' rather than 'intensive' farm. An 'intensive' example would be expected to have greater existing development (more fencing, troughs, dams, etc), thereby lessening compliance requirements. Because of this, the case study was re-evaluated using a practical interpretation of workbook specifications, whereby only the 'intensive' areas of the farm were considered. Harder hill areas were excluded, resulting in fewer troughs, culverts, dams and fencing requirements. Total cost reduced to $50,700. This is still substantial, but represents a valid reflection of development stages that can be expected between 'intensive' and 'extensive' farms.

Conclusion: Achieving One Plan N-targets would not be difficult for this property, primarily because it represents an 'extensive' operation with low N-losses. However, extensiveness means the property is less developed in terms of fencing, troughs, dams and culverts, and will therefore find FARMS compliance requirements more challenging. A literal interpretation of these requirements could result in extreme compliance costs (~$475,000), but a more pragmatic interpretation that only includes the 'intensive' portion of the farm would result in considerable lower compliance costs (~$50,700). Financial outlay is still high, but this represents an extreme case and lower requirements/costs would be expected for more developed sheep and beef properties that do actually qualify as being 'intensive' under Rule 13-1.

FARMS development: Key issues identified include: a) Potentially high compliance costs for sheep/beef operations, b) Correctness of LUC classifications were challenged, and c) Comparatively fewer N-mitigation options available to low intensity sheep and beef farmers.



Map: Property map for Case Study #4

Case study #5: Proposed dairy conversion

Description: Proposed dairy conversion (264 ha) from sheep/beef under moderate rainfall (1470 mm) near Pahiatua. Aiming to run 2.7 cows/ha and produce 330 kg MS/cow, while retaining the balance of the farm in sheep and beef. Proposed dairying area is rolling to flat with a high capability for sheep and beef, but a moderate to low capability for more intensive uses.

Contaminant assessment: Predicted N-leaching is calculated at a 30 kg N/ha/yr for the dairy platform, which averages down to 15 kg N/ha/yr when calculated for the entire farm. P-loss risk to water assessed as HIGH (EXTREME for dairy, MEDIUM for sheep/beef).

One Plan N-loss limits: Calculated at 11 kg N/ha/yr for the first year, and gradually decreasing to 10 kg N/ha over 20-years. Dairy N-limit is 13 kg N/ha and sheep & beef is 10 kg N/ha. Dairy N-limit is low because only 30% of the conversion area is represented by land commonly associated with dairy farms. The conversion would need to reduce N-loss by 4 kg N/ha/yr to be compliant. This also depends on the coexistence of the sheep and beef enterprise to average dairy N-loss down to an achievable level.

Mitigation options: Five promising options were identified and evaluated.

Option	Potential effectiveness	Economic implications	Practicality
N-inhibitors	N-loss ↓ **1.9 kg N/ha/yr**	$71,200 net cost but only a 7.5% yield increase to break even; scope for higher increases	High
Off-farm winter grazing + reduced supplements	N-loss ↓ **1 kg N/ha/yr**, bug risk↓ & P-loss↓	$61,430 cost but potentially offset by utilising winter pasture ($20,000 - $40,000 revenue)	Low
Increase effluent area + feeding pad time	N-loss risk↓ & P-loss risk↓ & bug risk↓ (modelled N-loss reduction is minor)	$2,000 per year for spreading effluent solids across whole farm	Low
Wintering barn or herd home	N-loss ↓ **2 kg N/ha/yr**, bug risk↓ & P-loss↓	$240,000 cost for wintering barn and $411,000 cost for herd home	Medium
Alternative to Triticale crop	N-loss ↓ **2.7 kg N/ha/yr**	$27,700 cost of purchasing equivalent silage	High

Compliance requirements: In being a new conversion, One Plan and Clean Streams Accord compliance is assumed by default. The only exception is having to reduce N-loss by 4 kg N/ha/yr. Adopting N-inhibitors, plus purchasing Triticale silage (or equivalent) rather than growing it on-farm, both promise to reduce N-loss to targeted levels. Longer term targets would be more challenging, and an investment into a wintering barn or herd home may be required.

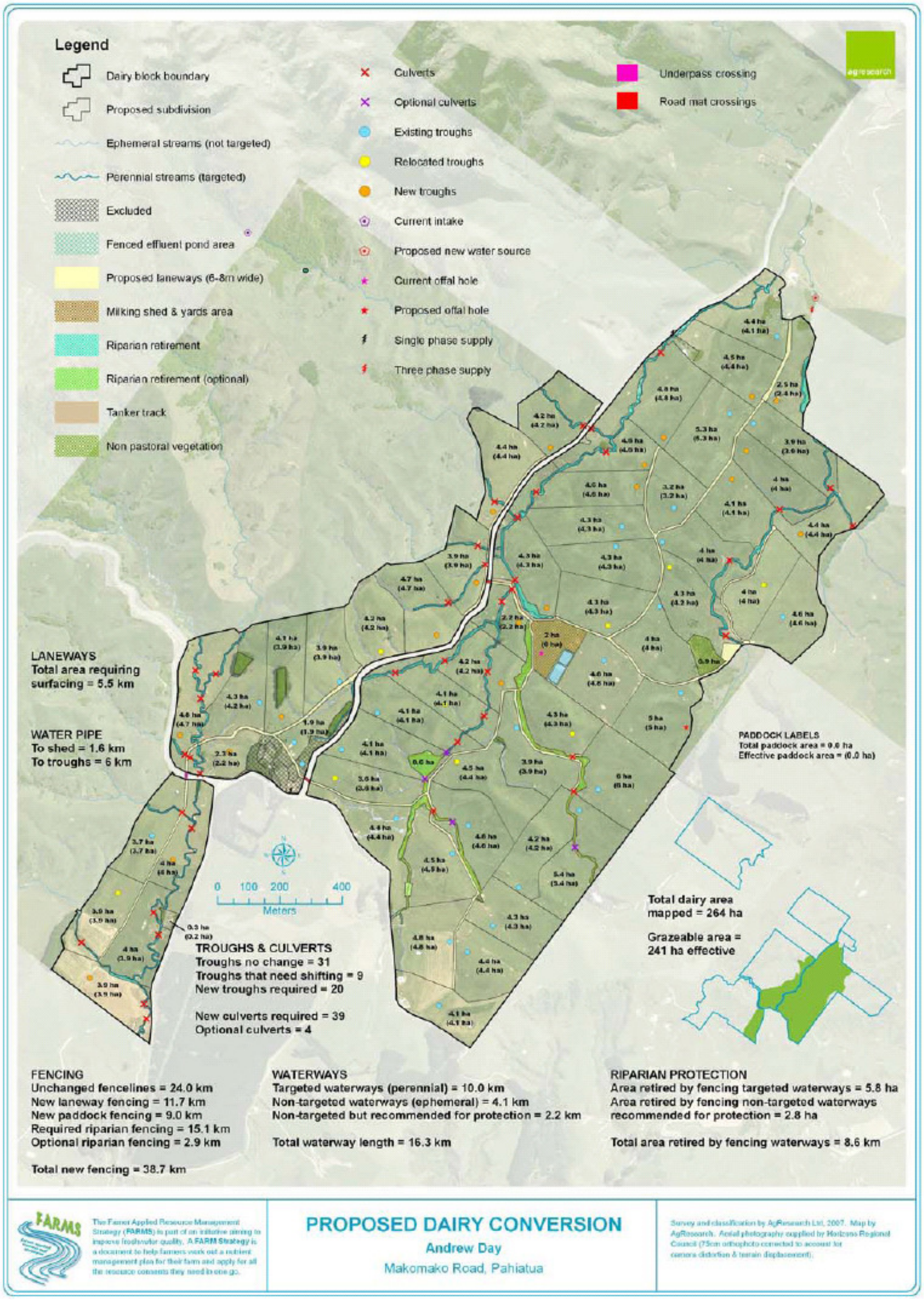
Compliance cost estimate: Cost of full compliance is estimated at $27,700. This represents the cost of purchasing Triticale silage (or equivalent) over and above the cost of growing it on-farm. Inhibitor use is predicted to pay for itself through increased pasture yields. Investing in a wintering barn would increase total cost by an estimated $240,000 (or $411,000 for a herd home).

Implications for conversion viability: The conversion would require an investment of ~$5.8 million. At a conservative payout ($5.40/kg MS), net surplus is estimated at ~$168,000 in year three, which is only ~$16,300 above what is currently achieved under sheep and beef. However, capital gain is a significant consideration (~$557,000), and the conversion would be an attractive investment under a higher payout (i.e. at $6.90/kg MS). Viability is jeopardised at a $5.40 payout, particularly if a wintering barn or herd home were included. As a tentative statement, compliance costs under higher payouts would not make the dairy conversion unviable.

Conclusion: Achieving initial One Plan N-targets would be readily achievable by adopting inhibitors and purchasing silage. Longer term targets may require additional options such as constructing a wintering pad or herd home. Compliance costs may jeopardise conversion feasibility at low payouts, but not at the high payouts currently being predicted. Even so, compliance costs are but one of many factors that need consideration before deciding to invest in a dairy conversion, and a more comprehensive analysis is recommended outside of this research exercise.

FARMS development: Key issues identified include: a) N-loss compliance implications for converting marginal land, and b) Implications for farms that straddle multiple Water Management Zones.

Note: Full dairy conversion analysis by Sheppard Agriculture.



Map: Property map for Case Study #5

Case study #6: Irrigated mixed enterprise agribusiness

Description: Mixed sheep/beef/dairy/cropping agribusiness (778 ha) under a low to moderate rainfall (1141 mm) supplemented with irrigation, near Marton. Dairy platform running 800 cows/ha and yielding 434 kg MS/cow. Mix of terraces and alluvial flats with high capability.

Contaminant assessment: Whole farm N-loss at a low 16 kg N/ha/yr (17 kg, 12 kg and 24 kg for dairy, sheep/beef and cropping respectively), attributable to generally low stocking rates, many N-reducing options are already practiced, and N-loss from intensive areas was 'diluted' by including less intensive and non-pastoral areas. P-loss risk was LOW for the farm (MEDIUM for dairy and cropping).

One Plan N-loss limits: High at 25 kg N/ha for 2014, decreasing to 20 kg N/ha over 20-years (87% of the farm is high capability LUC class 1 to 4 land). The farm is operating well-within its N-loss limits, and no N-reductions or special mitigations are required. There is a comfortable margin extending out for the full 20 years of consideration, such that the property would still remain compliant even under an intensification scenario of 1100 cows.

Mitigation options: While N-reductions are not required, several mitigations were evaluated either for future reference, or because they are a requirement under a different part of the FARM Strategy workbook.

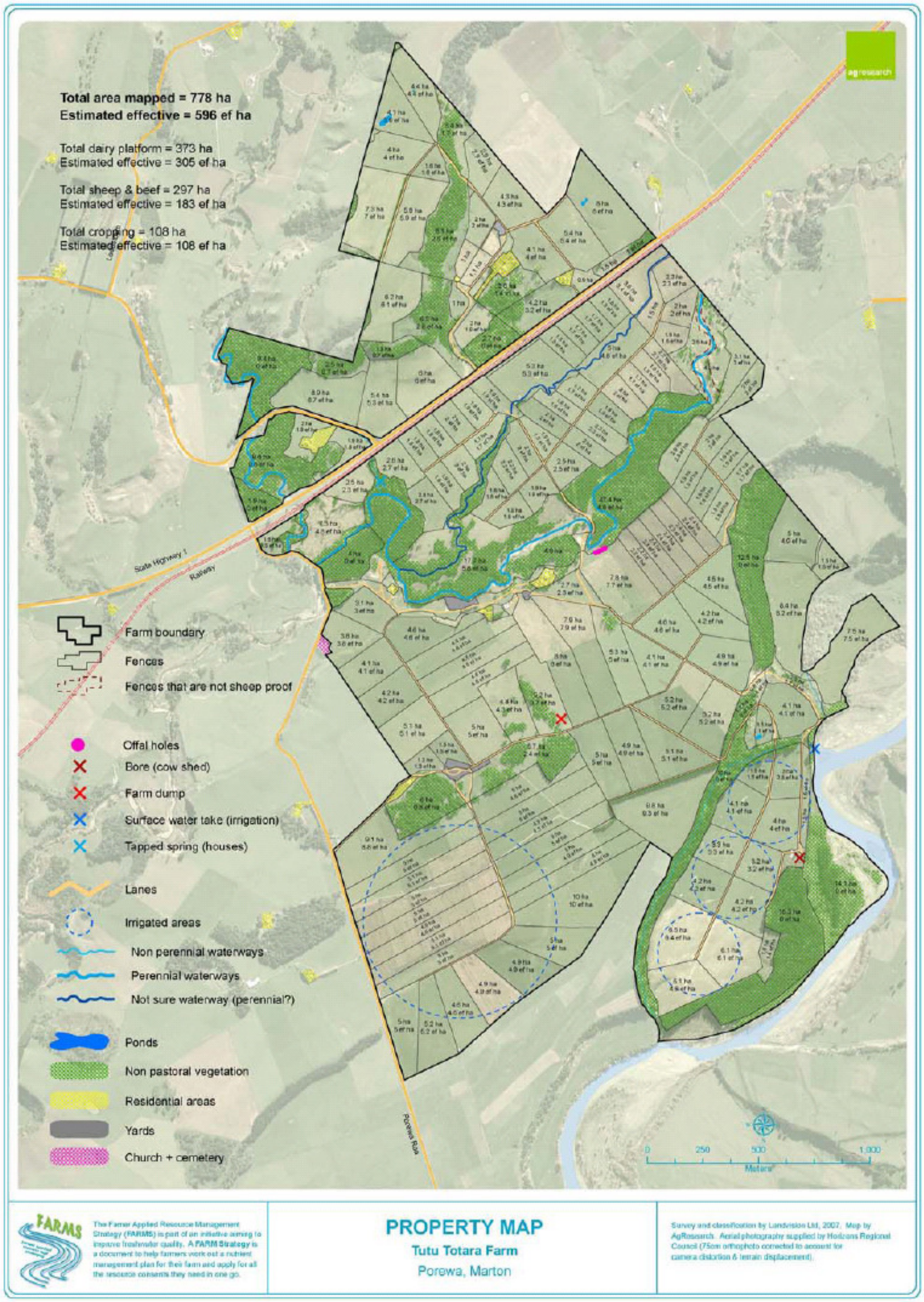
Option	Potential effectiveness	Economic implications	Recommendation
N-inhibitors	N-loss ↓ **1.4 kg N/ha/yr**	Only 5.4% yield response needed to break even; potentially more profitable	✓
Control sheep-yard runoff	Bug risk↓ & N-loss risk↓ & P-loss risk↓	$5,000 - $10,000 for effluent storage system	?
Fence waterways	Bug risk↓ & N-loss risk↓ & P-loss risk↓	$12,300 - $17,000 cost. Production losses negligible	✓
Decommission stock fords	Bug risk↓ & N-loss risk↓ & P-loss risk↓	Fencing costs built into fencing waterways. Alternative options already available (bridges)	✓
Improved dairy effluent system	N-loss ↓ **<1 kg N/ha/yr** for whole farm (↓ **37 kg N/ha/yr** for the Effluent Block)	Capital investment of $16,680 but offset by nutrient efficiencies worth +$12,000 per year	✓
Stop use of urea in winter	N-loss ↓ **1 kg N/ha/yr**	Estimated $69,000 lost revenue	×

Compliance requirements & costs: The sheep and beef unit was assessed as 'intensive' resulting in the identification of several non-compliant items. Total estimated cost ($36,000 – $45,900) includes Clean Streams obligations ($16,680), and would reduce substantially if the Regional Council exempts sheepyard effluent discharge requirements, the 'suspect' stream remains unfenced, and nutrient-use improvements are included (+$12,000/yr). FARMS implementation costs could be as low as $14,400.

Requirement	To comply with...	Recommendation	Cost estimate
Operate within N-loss limits	One Plan	No N-reductions or special mitigations necessary	-
No stormwater discharge to yards	One Plan	Install guttering & pipe to direct stormwater to land	$500
Exclude stock from waterways	One Plan (& Accord)	Sheep-proof 1.2 km existing fence; erect 1.6 km new fence; consider 0.9 km fence around 'suspect' stream	$12,200-$14,600
No stock fords or crossings	One Plan (& Accord)	Decommission stock fords	-
No offal hole <100m from river	One Plan	Relocate offal holes	$1,700
No direct discharge of effluent to water from the sheep yards	One Plan	Install effluent catchment & storage if sheepyard effluent requires special management (?)	$5,000 - $10,000
No dump <1m from water-table	One Plan	Decommission farm dump	-
Max effluent rate @ 35m^3/day & must have 2 days effluent storage	Accord (existing consent) & One Plan	Enlarge effluent area (62 ha), improve wash-down practices & install 420m^3 holding pond	$16,680 offset by ~$12,000/yr saving

Conclusion: Farming within One plan N-limits will not be a challenge for this farm, even if herd size is increased to 1100 cows. Of greater concern is compliance issues identified for the sheep/beef unit, and the inefficiencies associated with the dairy effluent system. Compliance costs could be substantial ($36,000 – $45,900), but nutrient-use improvements (+$12,000/yr) have the potential to balance capital costs over a longer period of economic consideration.

FARMS development: Key issues identified include: a) Nutrient modelling for complex enterprise mixes, b) Inconsistencies with One Plan catchment zoning, c) Farm straddled two Water Management Subzones, one targeted and the other was not, and d) Identifying a 'representative year' for OVERSEER® modelling when enterprise mixes are changing from year to year.



Map: Property map for Case Study #1

APPENDIX 2: EXAMPLE OF MITIGATIONS ASSESSMENT TABLE

TABLE: Relevance of common N-loss mitigation options (+ P-loss & faecal microbes)

MITIGATION OPTIONS	Issue & ranking[1]	Relevance or opportunity	NOTES
Mitigation options captured by Overseer			
Avoid winter (May, June or July) N-applications	N	HIGH	Dairy unit receives 50 kg N/ha/yr during winter
Ensure effluent application area is large enough to keep loading <150kg N/ha/yr	N, bugs, P	HIGH	Current effluent area results in loads far greater than 150 kg N/ha/yr
Avoid winter effluent applications	N, bugs, P	LOW	Given the soil characteristics and reasonable low annual recharge rates, deferred irrigation is unlikely to be necessary. However, it is acknowledged that production responses of using effluent would be greater outside of the winter months.
Use supplements with N-concentrations that are lower than pasture (or higher energy content - e.g. maize)	N	LOW	Currently use a high proportion of high-E low-protein supplement in the form of maize silage.
Replace fertiliser N with equivalent supplement-N	N	LOW	Cannot be used strategically to target periods of growth when N is most needed.
Ensure other nutrients are non-limiting (optimal) for max yield per kg N input	N	LOW	Soil tests indicate levels for major nutrients are near optimum or above.
Decrease use of N-fertiliser	N	LOW	While urea rates are high, current N-loss is well within permitted N-limits. Reducing current rates would have implications for current production levels.
Decrease stocking rate	N, bugs	LOW	Stocking rate is not particularly high (2.6 cows/ha).
Change stock type or class	N	LOW	Not suitable. Already have a variety of land uses and stock types.
Reduce imports of supplementary feed	N	LOW	Reductions have major implications for current levels of production, and given that current N-loss is within N-limits, feed reductions are not necessary.
Graze cattle off during winter (May, June, July)	N, bugs, P, sed	LOW	All ready practiced with 50% of herd.
Use a sealed wintering/standing pad with effluent collection and storage system	N, bugs	LOW	All ready practiced with 50% of herd.
Increase supplement exports off farm	N	LOW	Not financially prudent at current time.
Other mitigation activities			
Time N-fertiliser application for periods when N demand is greatest[2]	N	LOW	Already practiced[4].
Avoid high-rate, single dressings of N-fertiliser. Use split dressings (20-50kg N/ha per dressing)	N	LOW	Already practiced[4].
Adjust N-fertiliser rates & timings seasonally to respond to actual or expected production demand (seasonal variations)	N	LOW	Already practiced[4].
Use an N-fertiliser product with an N-uptake efficiency that is better than the current N-product	N	LOW	Urea is a cost effective source of fertiliser-N. However, see note on urease treated urea below.
Avoid N-applications when soils are saturated (leaching/runoff & low plant activity).	N	LOW	Already practiced[4].
Avoid N-applications during excessive dry periods (plant N-uptake low)	N	LOW	Already practiced[4].
Delay N-applications directly after dry periods until pastures have started recovering	N	LOW	Already practiced[4].
Ensure an adequate buffer distance from waterways when applying fertiliser[3]	N, P	LOW	Already practiced[4].
Use urea product treated with urease inhibitor	N	HIGH	Proven potential to reduce N-leaching but degree of effectiveness likely to be lower in the Marton area (relative to colder areas in the region).
Ensure you can actually use the extra grass grown when N-fertiliser is used	N	LOW	Already practiced[4].
Spray nitrification inhibitor according to manufacturer recommended rates and timings, particularly on highly stocked areas (e.g. camps)	N	HIGH	Proven potential to reduce N-leaching but degree of effectiveness likely to be lower in the Marton area (relative to colder areas in the region).
Ensure effluent storage facilities do not overflow (part. winter)	N, bugs, P	HIGH	Current sump capacity is insufficient and overflow occurs, particularly when there is a pump failure
Use adequate buffer distance from waterways when applying effluent (+20m)	Bugs, N, P	LOW	Low relevance with existing system.
Other best management works			
Ensure all paddocks are supplied with adequate troughs or dams	Bugs, N, P, sed	LOW	Farm owner has assured that all paddocks have reticulated stock water
Replace fords with bridges or culverts	Bugs, sed, N, P	HIGH	There are two major stock-fords on the sheep and beef unit, likely to be subject to high stock-crossing densities at certain times of the year
Exclude stock from flowing waterways by fencing	Bugs, sed, N, P	MEDIUM	Only a small proportion of sheep & beef streams are currently unfenced (~30%), most of which fall within intermittently grazed areas
Create wetland attenuation zones where runoff converges	Bugs, sed, N, P	LOW	However, the ungrazed boggy area below the feed pad could be developed into a receiving wetland to offset risks associated with effluent overflow
Create riparian attenuation zones wider than 10-30m	Bugs, sed, P, N	LOW	Most riparian areas are already fenced and well vegetated. Where not fenced, the gains would likely be small, and a more logical option may be to retire bush areas adjacent to streams
Ensure runoff from tracks/lanes is not channelled into streams near crossings	Bugs, sed, N, P	LOW	Generally adequate to good lane & drainage designs
Ensure there are no major leaks in the effluent irrigation system (e.g pipe joins).	N	LOW	The effluent line was examined and there was no evidence of major leaks
Invest in a high efficacy effluent treatment/disposal system (e.g. digesters)	N, bugs, P	LOW	For this farm there are many other lower cost options.
Ensure runoff from yards, feed pads, etc. does not go directly into waterways	Bugs, N, P, sed	HIGH	Dairy: Effluent sump overflow discharges to a 'drain to no where' (i.e. effectively a discharge to land), which is not a recognised concern. Sheep yards: Runoff and (artificial) drainage from the sheep yards both represent discharges to the adjacent Porewa Stream.
Ensure effluent storage facilities are sealed	N, bugs	LOW	Effluent sumps are sealed concrete
Ensure effluent storage facilities are of a sufficient size	N	HIGH	Current sump capacity is insufficient and overflow occurs, particularly when there is a pump failure
Store leakable supplementary feeds (e.g. silage) on a sealed base with an effluent collection/storage/disposal system	N	LOW	Maize silage is stored in a concrete bunker and silage effluent enters the main effluent disposal system

[1] *N* = nitrogen loss; *P* = phosphorus loss; *bugs* = faecal microbes; *sed* = sediment

[2] When pastures are higher than 25mm or 1000kg DM/ha, are actively growing, when soil temp >6degrees

[3] See formulas in Spreadmark code of practice

[4] Based on farmer assurance. Cannot be assessed conclusively within project limits. Assumed compliant until proven otherwise.

APPENDIX 3

REFERENCE GUIDE

Farmer Applied Resource Management Strategies

Please ensure that you are working to the most up
to date FARM Strategy material available from
www.horizons.govt.nz

Version: 1.01
Release date: September 09

CONTENTS

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INTRODUCTION

The quality of Manawatu-Wanganui rivers, streams and lakes is regularly measured by Horizons Regional Council as part of their water quality monitoring programme. Results show that nutrient levels in eighteen key catchments are consistently far in excess of recommended guidelines, and well above quality thresholds required by the people of the Manawatu-Wanganui Region[1].

Agricultural diffuse-sources have been identified as major contributors of nutrient and bacteria within these catchments[2]. Industrial and city point-sources are relatively minor.

Farming is undeniably important to the Region. It provides jobs, wealth and produce, all of which underpin the Region's prosperity and wellbeing. However, this in no way justifies farming's contribution to water quality decline. Water is a limited and shared regional resource, and its quality is important to agricultural and non-agricultural users alike.

Horizons Regional Council is legally obligated to protect the Region's water resources[3]. Major improvements have been achieved in the past fifteen years, particularly with the reduction and management of point sources. However, ongoing water quality decline suggests that progress has not fully kept pace with the growth and effects of farming.

Heightened management around certain high-risk farming activities and land uses is now required under the Council's proposed One Plan. In particular, all intensive farming operations located in 18 priority catchments, and all new conversions anywhere in the Region, are now required to prepare a FARM Strategy[4] under Rule 13-1.

A FARM Strategy is an outline of what a farm must do to achieve compliance, and an application for a *FARM Strategy resource consent*.

This FARMS kit is provided to assist in the preparation of a FARM Strategy and resource consent application. It includes a combined workbook and consent application form, with a comprehensive Reference Guide to help with the application process. Anyone who has ever completed a basic income tax return should have little trouble in completing the FARMS consent application form.

Work through the combined workbook/application using the Reference Guide where necessary. Further assistance is available by contacting the Council. You will also need to prepare (or have prepared) maps and an Overseer Nutrient Budget. Please read all questions carefully, answer as clearly as possible, and ensure all relevant sections are completed. It is in your best interests to submit a well prepared application; this will save you both time and processing costs.

PLEASE NOTE THAT THIS REFERENCE GUIDE AND WORKBOOK ARE PROVIDED AS A GUIDE. THE REQUIREMENTS OF RULE 13-1 HAVE BEEN INTERPRETED IN SOME CASES TO PROVIDE CONTEXT. IN ALL CASES THE PROPOSED ONE PLAN PROVIDES THE DEFINITIVE DESCRIPTIONS OF LEGAL REQUIREMENTS.

Eighteen of the Region's river catchments have nutrients far in excess of acceptable levels

Diffuse agricultural nutrients are known to be the major source

All intensive farms located in target catchments, and all new conversions, are required to have a FARM Strategy (Rule 13-1)

Anyone who has ever completed a basic income tax return should have little trouble in completing the application.

[1] See Roygard (2007), Ledein et al. (2007), Ausseil & Clark (2007), Clothier et al. (2007).

[2] Ledein et al., 2007.

[3] Under the Resource Management Act (1991)

[4] FARMS is an acronym for Farmer Applied Resource Management Strategy.

Who requires a FARM Strategy?

- All conversions to more intensive land uses (e.g. dairy conversions) anywhere within the Manawatu-Wanganui Region.
- All intensive farms operating within priority catchments (Figures 1 and 2).
- If you are unsure about whether your farming operation requires a FARM Strategy, please contact the Council's consent team on freephone 0508 800 800.

Figure 1: Intensive farms include:

- All dairy farms
- All cropping operations
- All commercial vegetable growing operations
- Irrigated sheep and/or beef farming operations

What about piggeries and poultry operations?

- Commercial piggeries and poultry farms do not require a FARM Strategy, UNLESS commercial pig or foul production is part of a mixed farming operation (e.g. a dairy farm with a small piggery for commercial supply).

What if my farm straddles more than one catchment?

- If all the straddled catchments qualify under Rule 13-1, then a FARMS is required.
- If the majority of the farm area falls within a priority catchment, then a FARMS is required.
- In cases where the portion of a farm falling within a priority catchment is either small or unclear, then Council reserves discretion as to whether a FARMS is required. Please contact the Council's consent team on freephone 0508 800 800.

What about support blocks?

- A support block may be a runoff, a satellite block not connected to the main farm, or a part of the farm that is never used for intensive enterprises.
- All support blocks that are located within the same priority catchment, and are farmed intensively, should be included in the FARM Strategy.
    - Intensive support blocks located in different priority catchments require their own separate FARM Strategy.
    - Intensive support blocks located in non-priority catchments can be excluded.
- Non-intensive support blocks located in the same priority catchment can be included at the applicant's discretion. Note that inclusion will likely change farm N-caps, Overseer leaching losses, and the number of compliance requirements.

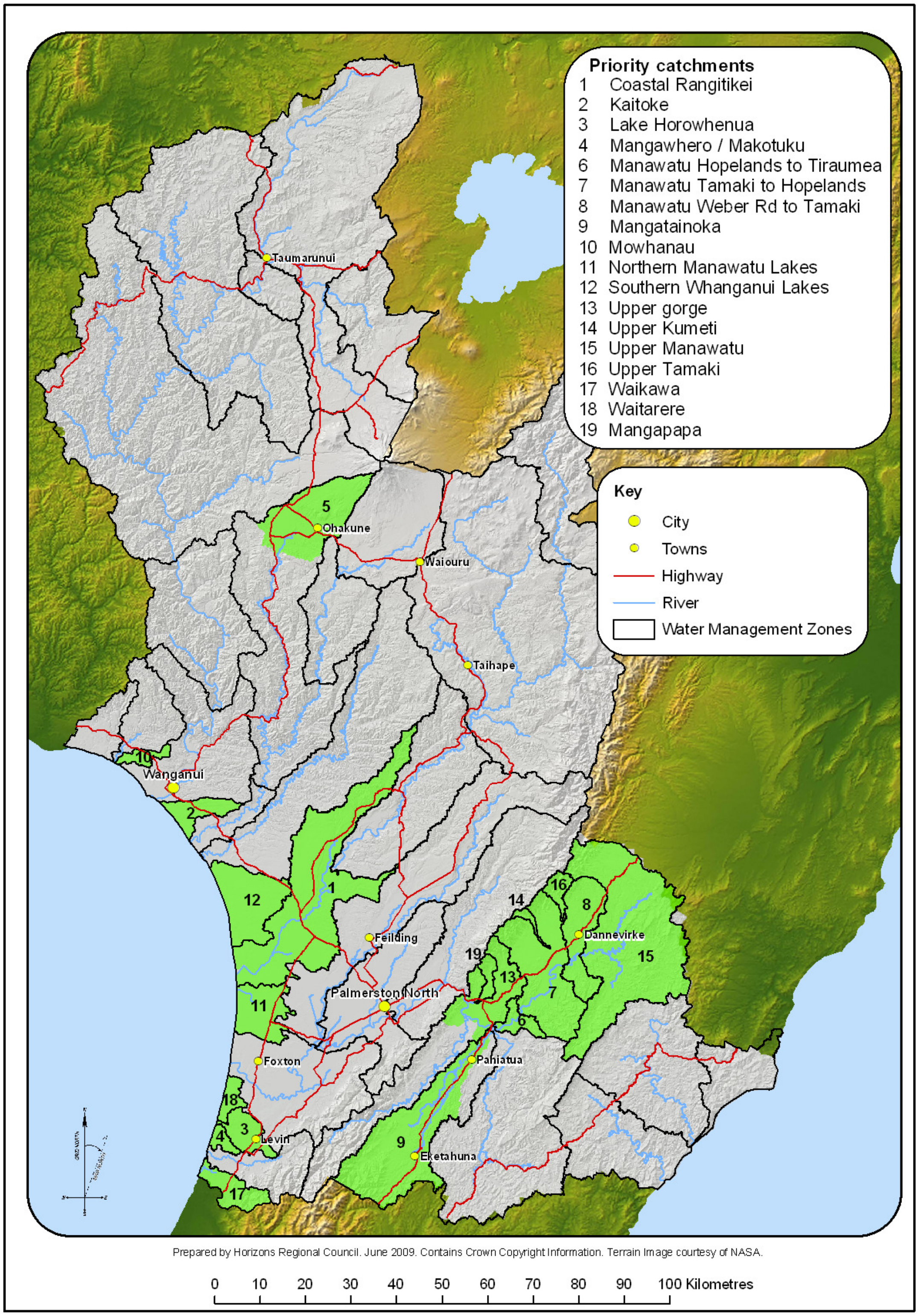


Figure 2:

Figure 3: Priority FARMS catchments. Existing intensive farming operations in these catchments are required to have a FARM Strategy. Please contact the Council for the precise eligibility of individual farms.

FARM STRATEGY CONSENT APPLICATION GUIDELINES

A.1 The form is a combined workbook and consent application.

A.2 How to fill out each field is explained in this Reference Guide. Each application form number (A.1, A.2. etc.) has a corresponding number in the Guide.

A.3 The Council requires sufficient and correct information before processing the resource consent application.

A.3.1 Please read fully the requirements of the consent application, including the Reference Guide and Fact Sheets available from the Council, before preparing the application and necessary supporting information.

A.3.2 If you are unsure as to what information to include with your application, please seek clarification before submitting the application.

A.3.3 If the application does not contain the necessary basic information the Council may return the application to you and not commence processing it until it is completed.

A.3.4 If the consent is granted and the information is later found to be intentionally misleading or falsified, then the consent may be reviewed. A new consent application may then be required at the applicant's expense.

Section 1: Applicant information.

1 Section 1: Applicant information

1.1 Who will be the **consent holder**?

The consent holder is also known as **the 'applicant'**. The consent holder can be a single person, a group of people, or a company. Trusts, Estates and any other entity that is not legally enforceable, cannot apply for a resource consent.

Groups and companies must nominate a 'contact person'. This is the person that the Council will communicate with as a representative of the group or company.

1.2 Who will be making the consent application?

This refers to a consultant or agent engaged to undertake the consent application process for the applicant. Leave blank if the no consultant or agent is used.

Section 2: Property details.

2 Section 2: Property details.

2.1 Physical address. This is the address of the farm, including the rural number, road name, and rural location (e.g. Kimbolton, Eketahuna).

2.2 Legal description. A unique number reference to a parcel of land, based upon government surveys, which is recognised by law (e.g. LOT 9 DP 25657). A farm can have one or many legal descriptions (depending on how many land parcels have been surveyed). The Council will need to know them all for a consent application. Use an extra sheet of paper if many legal titles make up the farm (attach to the application form).

Legal descriptions will appear on your annual Horizons Regional Council Rates Invoice. Alternatively, parcel legal descriptions can be obtained over the internet using the Council's Rates Information Database (also see Rates Valuation Number below).

http://www.horizons.govt.nz/default.aspx?pageid=36

2.3 Farming type. Tick one or more options to indicate the farm's designated land uses.

2.3.1 New conversion. Refers to any dedicated change to a new and intensive land use (dairy, cropping, commercial vegetable growing, irrigated sheep/beef).

2.3.2 Dairy. Properties greater than 4 hectares and mainly engaged in the farming of dairy cattle for milk production. Excludes dairy grazing arrangements.

2.3.3 Sheep/beef. Refers to sheep, beef, and mixed sheep/beef farming properties >4ha **that have part of the farm irrigated**. Non-irrigated sheep or beef farms are not required to prepare a FARMS.

2.3.4 Cropping. Any crop, or combination of crops, in any year, covering more than 20ha, or more than 10% of the effectively farmed area of the property, including land leased for the purpose of cropping, whichever is the greatest. A "crop" is defined as cereal, coarse grains, oilseed, peanuts, lupins, dry field peas or dry field beans. This does not include fodder crops that will be fed or grazed on the property.

2.3.5 Commercial vegetable growing (and market gardening). Refers to properties greater than 1 ha mainly engaged in growing vegetables for human consumption (except dry field peas or beans), tree nuts, citrus fruit or other fruit.

2.4 Rates Valuation Number. This is a reference number allocated to the property by Quotable Value New Zealand Ltd. to identify the property.

Your RV Number will appear on your annual Horizons Regional Council Rates Invoice. Alternatively, RV Numbers can be obtained over the internet using the Council's Rates Information Database.

http://www.horizons.govt.nz/default.aspx?pageid=36

2.5 Dairy supply number (dairy farmers only). Please supply your dairy supply number.

2.6 Total Farm Area. This is defined as the total legal area of the property, PLUS all other areas of farmed land. This may be leased land, gazetted land, or redundant unsurveyed land (e.g. new land made available by river bed changes). While this land is not owned, it should be included in the Total Farm Area if it is used regularly for farming purposes. Also note that this Total Farm Area should be used for calculating N-caps, and for preparing the nutrient budget.

2.7 FARMS Catchment. Refer to Figure 2, and write in the name of the catchment(s) that the farm is located within. If you are unsure, please contact the Horizons consents team on 0508 800 800.

2.8 Date that Rule 13-1 comes into effect. Each priority catchment has its own start date that indicates when Rule 13-1 will come into effect for that particular catchment (Table 1).

Table 1: Catchment start dates for when Rule 13-1 comes into effect

Catchment	**Date when Rule 13-1 comes into effect**
Mangapapa	1 April 2009
Mowhanau	1 April 2009
Mangatainoka	1 April 2010
Upper Manawatu above Hopelands	1 April 2011
Lake Horowhenua	1 April 2012
Waikawa	1 April 2012
Manawatu above Gorge	1 April 2013
Other south-west catcments (Waitarere and Papaitonga)	1 April 2013
Other coastal lakes	1 April 2013
Coastal Rangitikei	1 April 2014
Mangawhero/Makotuku	1 April 2015

Section 3: Farm maps.

3 Section 3: Farm maps.

3.1 Land Use Capability (LUC map). LUC is a classification of land according to its agricultural capability (see Lynn et al., 2009 for more information). Eight classes are recognised, whereby Class 1 land has the highest capability suitable for the most intensive uses, through to Class 8 that has the least agricultural productive value (e.g. gorges, waste land). LUC is used in the FARM Strategy resource consent to calculate farm N-caps; a farm with high capability land (Classes 1 to 4) will have generous N-caps, while a farm dominated by marginal land will attract less generous N-caps.

Option 1: Farm map from regional LUC. All of the Manawatu-Wanganui Region has LUC classified at the regional scale (1:50,000). A farm map based on regional LUC can be obtained from known service providers listed in Appendix 1. Note that this is a low or nil cost option, but the quality of information will be generalised (detailed farm LUC classes will be omitted).

Option 2: Farm map from special LUC survey. Detailed farm LUC (scales of 1:5,000 to 1:20,000) can be mapped by qualified surveyors. A list of qualified LUC surveyors known to the Council is provided in Appendix 1. Using a more detailed LUC map may increase or decrease farm N-caps depending on the type of landscape.

The Council will accept either type of LUC map. It is at the applicant's discretion as to which type of map is used in the calculation of farm N-caps.

The map must include a scale bar, north arrow, and a table showing the hectare area of each LUC Class.

Farms with permanent irrigation may apply to have their irrigated land classified into higher capability categories. Reclassification can only be undertaken by a qualified LUC surveyor, and the Council reserves discretion over accepting/declining the reclassification.

3.2 Property map. This is a true-to-scale map of the farm that shows features of relevance to the requirements and conditions of the resource consent (features of relevance listed in the application form). Definitions for each feature are provided in Figure 3 (note: these definitions are also used in Section 8). A good accurate map is required so Council can check separation distances. Map size should be sufficient to clearly depict the location of features of interest. Providing a poor quality or illegible map may result in the consent being delayed or declined. The map must include a scale bar and north arrow.

Figure 4: Definition of items used in Section 3.2 (Property map).

Farm boundary: The outermost boundary of the farm. This may be defined by the legal property boundary, the fenced farm boundary, natural boundaries such as rivers, or a combination of all three.

Feed storage areas: Includes stacks, pits, bunkers, silos or sheds used to store appreciable quantities of supplementary feed such as silage, concentrates, and hay.

Feeding-out areas: Feed pad type areas where stock are contained at densities ≥0.8 su/1 m^2 (~9 m^2 per dairy cow) for > 30 min/day, and receive supplementary feed. This may include wintering pads, wintering barns, feed pads, stand-off pads, loafing pads, laneway areas, or sacrifice paddock areas.

Bores and water takes: The site at which water is extracted (i.e. the bore hole or the intake pipe).

Effluent block: The area of land that receives irrigated effluent. This is usually depicted as a number of paddocks. However, it is recommended that the effective effluent area based on irrigator spread be used (for improved nutrient budgeting and calculation of separation distances).

Effluent pond or sump: Effluent storage or treatment areas.

Farm dumps: Sites where refuse and waste is stored or dumped. FARMS is only concerned with active farm dumps (i.e. those that are currently in use, or will be used in the future).

Public roads: Any road or street open to the general public, that is under the jurisdiction of, and is maintained by, a local authority (see http://www.landtransport.govt.nz/legislation/road.html). Rule 13-1 does require the identification of paper or private roads.

Figure 3: Definition of items used in Section 3.2 (Property map) continued.

Residential plots: A section of land with a residence and curtilage (the enclosed land around a house or building).

Public areas: An area of land that is used by public groups or the general public. Rule 13-1 specifically recognises marae, schools, public buildings and public recreation areas (e.g. parks and sports fields). Native bush areas and reserves are not specified (however, see ecological areas below).

Ecological areas: Defined as Rule 13-1 *rare and threatened habitats* and *at risk habitats*. Generally refers to areas of indigenous vegetation, riparian areas and wetlands that have been rated as having important natural or ecological values. Please refer to *Schedule E: Indigenous Biological Diversity* of the proposed One Plan (http://www.horizons.govt.nz/default.aspx?pageid=170) for full definitions, and a list of recognised habitats.

Archaeological sites: Places of significant historical or cultural value. Rule 13-1 specifically recognises all archaeological sites, waahi tapu and koiwi remains that are identified by: 1) District councils in their district plans; 2) The NZ Archaeological Association in their Site Recording Scheme; and the Historic Places Trust in their Register of Historic Places, Historic Areas, Wahi Tapu and Wahi Tapu Areas. Generally most recognised archaeological sites are identified in district plans (the map sections).

Waterways: Includes both permanently and intermittently flowing waterways, within a defined bed (as defined in the Resource Management Act 1991), which is greater than one metre in width on average (averaged within the property boundary). A waterway may be a water course, stream, creek, brook, or a river, and it may be natural or artificially modified (i.e. includes realigned or modified channels). A permanent waterway is to be permanently fenced. An intermittent waterway is to be fenced when flowing and is accessible to stock.

Waterbodies: Any body of fresh water surrounded by land, such as a dam, reservoir, pond or lake. Includes natural waterbodies larger than $1000m^2$ and artificial waterbodies larger than $5000m^2$. Excludes effluent ponds.

Unbridged or un-culverted water crossings: Any ford or stock crossing of a waterway.

The Coastal Marine Area: All foreshore and seabed areas between the 'mean high water springs' (average of the high tides after each new and full moon, identified by seaweed and driftwood lines) out to 12 nautical miles offshore, and up rivers for a distance of one kilometre or five times the river width, whichever is less. These areas are defined as maps in *Schedule H: Coastal Marine Area, Zones and Protection Areas* of the proposed One Plan (http://www.horizons.govt.nz/default.aspx?pageid=170).

Section 4: Calculate farm N-caps.

4 Section 4: Calculate farm N-caps.

4.1 Enter the area in hectares of each LUC Class. The LUC Class is the first component of the LUC code (LUC Class, Subclass and Unit). For example, LUC 6e12 is broken down as LUC Class 6 (or VI), Subclass = e (erodibility), Unit = 12. The sum of all farm LUC classes must equal total farm area.

4.2 Reference N-caps. These are general N-loss limits that have been calculated for regional LUC classifications (see Carran et al., 2007 for more information) according to four implementation periods (Table 2). N-caps become successively tighter with each implementation period. The values represent how long and how much it will take to achieve today's water quality expectations.

Table 2: One Plan N-cap reference values

	Reference values by LUC Class (kg N ha^{-1} yr^{-1})							
	LUC 1	**LUC 2**	**LUC 3**	**LUC 4**	**LUC 5**	**LUC 6**	**LUC 7**	**LUC 8**
Year 1*	32	29	22	16	13	10	6	2
Year 5	27	25	21	16	13	10	6	2
Year 10	26	22	19	14	13	10	6	2
Year 20	25	21	18	13	12	10	6	2

* *Refer to Table 1 for catchment start dates*

4.3 *No help required*.

4.4 *No help required*.

4.5 Total farm leaching allowance. This is the total amount of nitrogen permitted to leach from the entire farm each year. Divide by 1000 for tonnes of N.

4.6 Farm N-cap. This is the maximum permitted N-leaching allowance for the farm expressed on a per hectare basis. The value calculated in Box 4c is for one implementation period only (see Table 2). Step 4 must be repeated to calculate farm N-caps for other implementation periods.

Section 5: Assess current N-leaching.

5 Section 5: Assess current N-leaching.

5.1 Have an Overseer® Nutrient Budget prepared by a certified operator.

- Certified operators have completed Massey University's Intermediate Sustainable Nutrient Management short course (http://flrc.massey.ac.nz/). Advanced operators have completed the Advanced Sustainable Nutrient Management short course.
- A list of recognised and accredited Overseer® operators is available from the Council (freephone 0508 800 800).
- The Overseer® Nutrient Budget must be prepared using total farm area.
- Use a long term average rainfall value in the model obtained from Horizons Regional Council.
- Modelling should be undertaken for the following year, based on actual production and inputs from previous years, where practicable.

5.2 *No help required*.

5.3 This calculation indicates if your farming operation is above or below the farm N-cap. The Overseer® *nitrogen leaching/runoff* value can be sourced from Overseer® output tables, either as the whole farm Nitrogen report, or the whole farm Nutrient Budget report (Figure 4).

Figure 5: Where to find the Overseer® *nitrogen leaching/runoff* value.

Nutrient Budget

Farm Budget for: Current

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Inputs							
Fertiliser	102	23	53	27	307	3	0
Effluent added	0	0	0	0	0	0	0
Atmospheric/Clover N	25	0	3	5	4	9	37
Irrigation	0	0	0	0	0	0	0
Slow release	0	3	8	6	3	4	5
Supplements	62	12	42	10	6	9	3
Outputs							
Product	50	8	12	3	11	1	3
Transfer	2	1	10	1	1	1	0
Supplements removed	0	0	0	0	0	0	0
Atmospheric	48	0	0	0	0	0	0
Leaching/runoff	24	0	13	44	54	21	64
Immobilisation/absorption	66	21	0	0	0	0	0
Change in inorganic soil pool	0	8	72	0	254	3	-23

trogen report

le farm report

	Units	Average NZ farm	Current farm
ts (farm average)			
lover N	kg N/ha/yr		25
ertiliser N	kg N/ha/yr		102
ther N	kg N/ha/yr		62
ronmental losses			
eaching loss	kg N/ha/yr	**30-50**	24
irect winter N loss	kg N/ha/yr		0
l loss from effluent pond to ater	kg N/ha/yr	**3-5**	2
2O emissions	kg N/ha/yr		3.4
es			
arm N surplus	kg N/ha/yr	**100-180**	139
l conversion efficiency	%	**25-40**	26
verage nitrate conc. in rainage (+/- about 30%)	mg N/ml	**5-10**	na

In-building a degree of flexibility or contingency is recommended. This is to account for seasonal variability and possible deviations between planned and actual farm management and production, which may impact on N-leaching losses. An example is adding a 5-10% contingency onto the N-leaching loss value (e.g. at 5% contingency 24 kg N/ha/yr would become 25 kg N/ha/yr).

Subtract the N-leaching loss from your farm's N-cap. If the difference is a positive number, then the N-cap balance is in credit, and no further action is required at this time. If the difference is negative, then you will need to complete section 6.

Section 6: Managing N-cap deficits.

6 Section 6: Managing N-cap deficits. This section only needs to be completed if your N-cap balance is in deficit (i.e. result from $5._3$ is a negative number).

6.1 Work with your Overseer® operator to identify options for reducing N-leaching. In being qualified and accredited, they will be familiar with N-management options and how to integrate them with different farming systems. Some options to discuss include:

- Ensure that N-fertiliser is applied when it is required (e.g. 4-6 weeks before a feed deficit), and when there is fast N-uptake by actively growing pasture (i.e. when N-response is likely to be high).
- Minimise or avoid the use of N-fertiliser during winter months (May, June and July). N-response rates are often at their lowest, and nutrient leaching potential is often at its highest.
- Aim to achieve optimal soil nutrient status. N-uptake potential is limited if plant growth is constrained by other limiting factors (Liebig's Law of the minimum – if one nutrient is missing or deficient, plant growth will be poor, even if the other nutrients are abundant).
- Replace fertiliser-N with supplements. The aim is to substitute the N-fertiliser-induced pasture growth with supplement at the same level of metabolisable energy, such that production remains unchanged. Your Overseer® operator will be able to calculate this substitution. Effectiveness is further improved if the supplement has a low N-content (see next).
- Use feed supplement types with a low N content. Good quality pasture contains far more dietary-N than can be utilised by the grazing ruminant, particularly during spring. Unutilised dietary-N passes through the animal to be excreted mostly in urine. Maize and maize silage are common low-N supplements used to improve dietary-N uptake efficiency.
- Decrease reliance on N-fertilisers, especially if usage is currently high (e.g. >150 kg N/ha for pasture). Pastoral farmers may consider the negative implications of becoming too dependent on N-fertilisers, particularly as it relates to less 'free' N fixed by clover (Table 3).

Table 3: Impact of fertiliser N on clover fixed N

Study	Amount of fertiliser-N applied (kg N/ha,yr)	Amount of biologically fixed N (kg N/ha,yr)	**Decrease in N-fixation (%)**
Ledgard et al. (1996)	0, 390	111, 47	**58%**
Crush et al. (1982)	0, 100	100, 70	**30%**
Ledgard (1995)	0, 200, 400	210, 170, 70	**19%, 67%**
Ledgard et al. (2001)	0, 200, 400	154, 99, 39	**36%, 75%**

From Saggar 2004

- Apply DCD nitrification inhibitors to pasture according to supplier specifications. DCD inhibitors are an emerging technology known to reduce N-leaching from urine patches and increase pasture dry matter production. However, effectiveness can vary with temperature, rainfall and location. Consult locally and discuss with your Overseer® operator regarding likely effectiveness of DCD inhibitors in your area.
- Winter dairy cattle off-farm in a non-priority catchment. The aim is to reduce urine-N and dung depositions at a time when the leaching risk is highest (within the priority catchment). Effectiveness is best when soil nitrate levels are low going into winter, and when stock are removed early (e.g. April, May, June).

- Winter dairy cattle on a wintering pad or equivalent. As above, the aim is to reduce direct animal excreta depositions to pasture during a high risk period. Additional considerations to improve effectiveness include using a sealed base (concrete), using a shelter-based system, and employing an optimal effluent collection, storage and application system (see below).
- Practice optimal effluent management according to location and dairy system:
  - Only apply effluent to land at optimal times. Soil water conditions should be in sufficient deficit to receive the rate of effluent applied without causing drainage losses. Recommended soil water deficits for different irrigators, rainfall and land type combinations are given in Section 9.
  - Especially avoid effluent applications during June, July and August in wetter locations. N-uptake rates are slow, and soils are often at or near field capacity. Loading soils with additional N and water from effluent during these periods can only exacerbate the N-leaching risk. This option may require a sufficiently sized holding pond (see below).
  - Ensure that the **effluent irrigation area** is of sufficient size to maintain annual N-loading within 150 kg N/ha/yr. This area can be calculated for individual dairy farming situations using Overseer®.
  - Use an effluent holding pond with sufficient capacity to store effluent over periods too wet for optimal irrigation. Refer to Section 9 for storage capacity guidelines.
  - Use a low rate application irrigation system (e.g. K-line, Larall), or low rate settings on other irrigator types (e.g. <12 mm/day).
- Some properties may be in a position to consider reduced imports of supplementary feed or even reduced stocking rates (e.g. if the level of extra production gained becomes marginal relative to costs associated with purchasing supplements, hiring labour, maintenance, or experiencing increased animal health problems).
- Use conservation tillage techniques for cropping or vegetable growing if suitable. Conventional ploughing and mechanical soil preparation accelerates organic matter decomposition and increases the concentration of available soil nitrogen at a time when crop demand is low. Leaching risks are high if these peak concentrations coincide with wet periods.
- Avoid extended fallow or stover periods between crops. Continued N-release from organic matter decomposition at a time of nil plant uptake can result in the accumulation of high concentrations of mobile soil nitrogen. Leaching risks are particularly high if the fallow term coincides with a wet period or soil drainage event.
- Closely match fertiliser-N with crop requirements. Applying fertiliser-N in excess of what the crop can actually use is unnecessarily wasteful. Most nitrogen (as nitrate) not taken up will remain in the soil only as long as the next soil drainage event.
- Avoid high-rate, single dressings of N-fertiliser. Use split dressings (e.g. 20-50kg N/ha per dressing) rather than large, single blanket dressings.
- There are many other recommended practices for reducing N-losses to the environment. A comprehensive list of best recommended practice is included with the Code of Practice for Nutrient Management (Fert Research, 2007) available with the Overseer® Nutrient Budgets software (www.agresearch.co.nz/overseerweb/) or directly from the Fert Research website: www.fertresearch.org.nz/code-of-practice. Qualified and accredited Overseer® operators are expected to be familiar with these practices.

Section 7: Attach Overseer reports.

7 Section 7: Attach Overseer® reports.

7.1 Please attach Overseer® Nutrient Budget reports so that they can be checked by Council staff. Key reports to attach include:

- Nutrient Budget report (for the whole farm, and for individual blocks).
- Nitrogen report (whole farm)
- Block nitrogen report
- Effluent block report.

Section 8: Compliance status checklist.

8 Section 8: Compliance status checklist. . This section covers nine controlled or discretionary activities:

1. The storage and discharge of farm effluent.
2. The application of farm effluent to land.
3. Storage and feeding of supplements.
4. Application of biosolids or soil conditioners to land.
5. The prevention of faecal contamination of water by stock, and from effluent runoff.
6. The application of fertiliser to farm land.
7. Minor surface water takes (<30m^3/d).
8. Minor ground water takes (<50m^3/d).
9. Major surface water takes (>30m^3/d).

The purpose of the checklist is to allow users to quickly assess their compliance status. If an item 'NEEDS ATTENTION' then compliance must be achieved before submitting a FARM Strategy Resource Consent. If 'NOT SURE' is checked, then you will need to seek advice or clarification before submitting a FARM Strategy Resource Consent (see 8.$_{43}$). Activities rated as CONTROLLED require additional information before consent application will be considered (see Section 9).

The checklist is provided as a guide. Wording has been adapted to improve context and interpretation. The checklist does not replace or supersede that contained in the proposed One Plan. In all cases the proposed One Plan should be referred to for definitive descriptions of Rule 13-1 activities and requirements.

8.1 ***Effluent from yards or pads must not discharge directly to waterways or waterbodies (including seasonally dry waterways or waterbodies)***: This includes drains that run alongside pads or yards if they feed into waterways or waterbodies. Effluent should be collected, stored and applied to land. Please refer to DEC (2006a) industry guidelines for effluent collection, storage, treatment and land application.

8.2 ***Effluent from ponds or sumps must not discharge directly to waterways or waterbodies (including seasonally dry waterways or waterbodies)***: Examples include:

- Pond or sump overflows to surface water due to insufficient capacity or mechanical breakdown.
- Leakage from pond or sump walls getting into waterways.
- Piped discharge to land (siphon pipes, overflows) where the outlet is placed near a waterway.
- Discharge or overflow to drains that feed into waterways.
- Flushing sumps, ponds or tanks to waterways.

8.3 ***Stormwater must not discharge to effluent ponds, sumps, or any hard surface that drains into effluent ponds or sumps UNLESS adequate storage has been provided for***: Stormwater can account for a sizeable volume of water contributing to total effluent production (e.g. 1200 mm/yr rainfall on an unguttered 5m x 10m milking shed roof would contribute 60,000 litres each year). Depending on the farm in question, stormwater contributions may mean:

- Larger ponds are required to store the extra 'effluent'.
- Increased labour requirements, longer pumping times and increased costs.
- Having significantly more effluent to irrigate may necessitate longer and more frequent irrigations, slower (deeper) application rates, and having to irrigate when soil conditions are less than ideal.

Discharging stormwater into the effluent system is permitted if it can be demonstrated that the practice will not elevate the risk of adverse effects. This will be readily possible in many drier areas that have good soils and extended irrigation opportunities. Likewise, some farms in wetter areas may already have large effluent ponds with sufficient capacity to store the extra 'effluent' until it can be applied safely in the drier months.

Alternatively, stormwater can be diverted so it doesn't enter the effluent system:

- Guttering systems can be installed on sheds and stormwater diverted to tanks or land.
- Divert stormwater from yards and pads at times when effluent is not being generated (e.g. when not milking, or when feed pads are not being used). Many diversion systems are available (sump plugs, inline Y valves, chutes, diversion gates). Refer to industry guidelines (e.g. DEC, 2006a).
- Shelter over yards or pads can be used to collect stormwater before it mixes with animal effluent.

Information provided in Section 9 will be used to calculate effluent production, storage and application particulars.

8.4 ***Effluent ponds and sumps must be adequately sealed to avoid seepage and leaks***: Maximum permeability must be no more than 1×10^{-9} metres per second (0.0864 mm/day). At this rate nitrogen leaching from the pond base will be similar to that leached from surrounding pasture. Sealing options include:

- In situ compaction of the pond base and walls if the subsoil already has a high clay content (>20% clay). Compaction to at least 150-200 kPa is usually sufficient to achieve 1×10^{-9} m/s permeability.
- Importing a clay-rich material to build a sealing layer if the subsoil has a low clay content (<8% clay) and/or high porosity (e.g. sands, gravel). Layer depth should be at least 600 mm and compacted to at least 150-200 kPa. An additional 100 mm of ordinary soil may be compacted on top of the clay to minimise damage if ponds are desludged with a digger.
- Synthetic pond liners.
- Low permeability concrete.
- Refer to industry guidelines for more information (e.g. DEC 2006a).

New ponds can be sealed during the construction process. A certificate from a Chartered Professional Engineer is required to demonstrate that sealing has been achieved. Existing older ponds are more difficult to check. Situations and signs to look for include:

- Older ponds constructed in highly permeable materials such as sand, gravel, stones or pumice.
- Pond level lowers substantially when not irrigating. In worst cases the pond may drain completely.
- Pond level rises substantially when the pond is dormant (i.e. not receiving effluent or stormwater). This may suggest groundwater is leaking into the pond.
- Leaky sidewalls – wet patches or localised areas of pasture growth are evident particularly during drier periods.

8.5 ***Effluent ponds and sumps must have the capacity to store a minimum 7-days of effluent production in the event of equipment failure***: Seven days storage provides sufficient time to repair an effluent system in the event of mechanical failure. Refer to Section 9 to calculate the volume of storage required.

8.6 ***Effluent irrigation pipes and equipment must not have any substantial leaks (e.g. causing local ponding)***: A leak can concentrate sizeable volumes of effluent to a small area (see Figure 9), particularly when pipes and equipment are moved infrequently. A leak is considered substantial when there is evidence of prolonged leakage, localised surface ponding, or the accumulation of sludge or slime materials.

8.7 ***A nutrient budget is required to help minimise the risk of elevated effluent-nitrogen loading***: Refer to Section 6.

8.8 ***Effluent applications must not be made on days when drift or odour is likely to affect neighbours:*** Effluent odour can be unpleasant; effluent aerosols can travel long distances in windy conditions; and effluent bacteria can remain viable out to 100 m or more (Donnison et al., 2004). If you may receive complaints regarding effluent odour or drift then you may wish to consider alternative areas for effluent application, irrigator systems that produce less aerosols, or avoiding applications on days when wind conditions are unfavourable. For occasional applications (e.g. spreading pond sludge) it is recommended that neighbours be forewarned (as part of being a good neighbour).

8.9 ***There must be no significant surface ponding of applied effluent***: Effluent ponding is a sign of poor effluent management usually associated with:

- Irrigating when soils are too wet or during rain.
- Application rates being to high for the soil type (e.g. low infiltration) or the conditions (e.g. too wet).
- Faulty or leaky equipment.

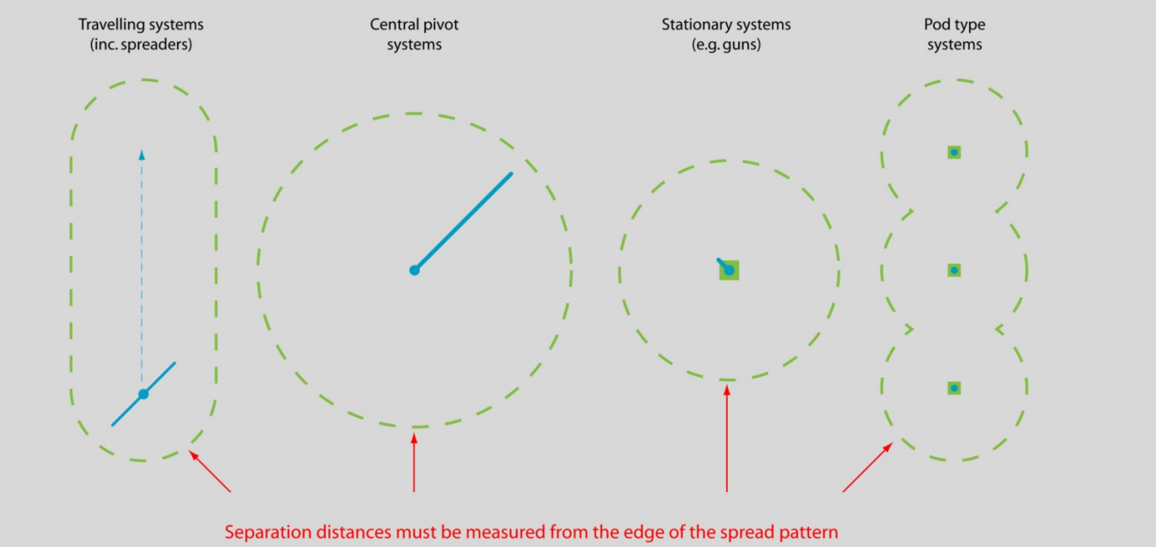
Ponding is defined as a depth of effluent greater than 25 mm covering a continuous area greater than $10m^2$, or a combined area greater than $20m^2$, at the time of irrigation, or any effluent on the soil surface five hours after irrigation has ceased.

8.10 ***The area of land receiving effluent must not be located within***:

- ***20 m of public areas, public roads, or residential plots.***
- ***20 m of surface water, bores, or the Coastal Marine Area.***
- ***50 m of ecological or archaeological areas.***

Separation distances are measured from the edge of the area that receives effluent, NOT from the irrigator or vehicle spreader (examples as Figure 5). See Figure 3 for definitions of public areas, public roads, etc. These features and the effective effluent application area must be marked on the Property Map (Section $3._2$) so Council staff can check separation distances.

Figure 6: Separation distances must be measured from the edge of the spread pattern.



8.11 ***Feed storage areas and feeding-out sites must be adequately sealed to avoid seepage and leaks. Hay storage is exempt. Small areas of silage storage are exempt if total area of unsealed pits and stacks per property is <500 m²***: Leachate from bulk supplementary feed can carry a high environmental risk. For example, silage leachate is typically very acidic and corrosive (pH of 4 to 4.5), and can have a nitrogen concentration 30-70 times higher than treated shed effluent (well-made silage can have the potential to leach 500-2500 kg N/ha/yr). *Feed storage areas* include stacks, piles, bunkers, pits, silos, sheds or any similar storage facility or site where bulk feed supplements are stored.

Feeding-out sites such as feedpads represent areas of high stock density and effluent concentration. They are defined as areas where stock are contained at densities ≥0.8 su/1 m^2 (~9 m^2 per dairy cow) for longer than 30 minutes per day, and receive supplementary feed. This definition may include wintering pads, wintering barns, feed pads, stand-off pads, loafing pads, laneway areas, calf rearing facilities, stock yards, or sacrifice paddock areas, if they meet the criteria given above.

Feed storage areas and feeding-out sites must be on a sealed base with a permeability rating no greater than 1 x 10^{-9} metres per second (0.0864 mm/day). Refer to Section $8._4$ for options to achieve this standard. Feeding-out sites that use soft surfaces (e.g. sawdust, chips or sand) will need to be sealed or lined underneath so leachate can be collected (see DairyNZ 2003, Dexcel 2005, DEC 2006a for guidelines).

It is also recommended that feed storage is covered to protect feed quality, and to minimise the potential for rainwater intrusion and subsequent leachate production.

Exceptions to this requirement include:

- Hay stored under cover.
- Straw.
- Wrapped haylage/baleage/silage provided the wrapping is sound.
- Small areas of silage storage are exempt IF the combined total area of unsealed silage pits, bunkers, stacks, etc. per property is <500 m^2.
- Feeding out onto pasture as part of grazing rotations.
- Break feeding when standing pasture is still the primary feed source.

8.12 ***Runoff <u>from</u> feed storage areas or feeding-out sites must be prevented from entering waterways or waterbodies***: All liquid runoff, effluent and leachate should be collected and managed as farm effluent during periods of use (see $8._{14}$ below). The area or site will therefore need to be designed in a way that allows for the collection of runoff, effluent and leachate (see DairyNZ 2003, Dexcel 2005, DEC 2006a for guidelines). When clean and not in use, stormwater from these areas and sites should be managed according to requirement $8._3$.

8.13 ***Runoff <u>into</u> feed storage areas or feeding-out sites must be prevented***: Surface water inflow adds to the risk of contaminants flowing out (via increased runoff or leaching depending on surface characteristics). If the area or site has an upslope area that may contribute to inwards runoff, then a diversion ditch or similar should be constructed.

8.14 ***Effluent and leachate from feeding-out sites and feed storage areas must be managed as farm effluent (i.e. according to requirements $8._1$ to $8._{10}$):*** In most cases collected effluent and leachate can be directed into the existing effluent system provided it has sufficient capacity (refer to Section 9).

- Effluent generated on pads is different to dairy shed effluent (higher solid content, higher nutrient content). Effluent system design will need to accommodate these differences. Refer to industry guidelines for assistance (DairyNZ 2003, Dexcel 2005, DEC 2006a).

- Old soft-surface cover materials (e.g. sawdust, chips or sand) can be composted and/or spread to land according to requirements $8._{17}$ to $8._{20}$.

- Effluent can be scraped and stockpiled provided the stockpile area has a sealed base (maximum permeability no greater than 1×10^{-9} m/s), runoff inflows are diverted, and runoff outflows are managed as liquid effluent (i.e. according to requirements $8._1$ to $8._{10}$).

- Some feed storage areas may require their own effluent/leachate/runoff storage facilities (e.g. silage bunkers located far from the dairy shed).

8.15 ***The storage or feeding out of supplementary feed must not result in any objectionable odour, dust or drift beyond the farm boundary***: Consider where you choose to site feed storage areas, and where you feed out. Note that this applies to feeding out on pasture.

8.16 ***Supplementary feed must not be stored or fed-out at locations that are within***:

- ***20 m of surface water, bores, or the Coastal Marine Area.***
- ***50 m of ecological or archaeological areas.***

Feed storage areas and feeding-out areas should be marked on the Property Map (Section 3.2) so separation distances can be checked by Council staff.

8.17 ***Biosolids or soil conditioners must not be applied or discharged to waterways or waterbodies***: The term *biosolids* refers to treated sewage and sewage sludge. Only *Aa grade biosolids* will be considered under a FARM Strategy resource consent (see $8._{19}$ below). *Soil conditioners* are materials that alter soil physical or structural characteristics. They are sometimes described as *soil amendments* and *soil improvers*. Examples of soil conditioners include:

- Sand, clay, gypsum, lime, perlite, pumice, vermiculite, diatomite, basalt.
- Compost, peat, humic compounds, biochar, agrichar, charcoal, bark, chips, sawdust, biological inoculants and activators, waste supplement.
- Surfactants (soil wetting agents), synthetic binding agents (e.g. water sorbing polymers).
- Manure with a low water content and/or high solids content (>20% solids) that cannot be applied by irrigator or spreader (e.g. pond crusts, dry stockpiled feedpad effluent).

Biosolids and many soil conditioners have the potential to alter aquatic conditions or contaminate water when applied at agricultural rates.

8.18 ***There must be no significant surface ponding if the applied material is liquid, or any runoff into waterways or waterbodies (liquid or non-liquid)***: Ponding is defined as a depth of liquid material greater than 25 mm covering a continuous area greater than 10 m^2, or a combined area greater than 20 m^2, at the time of application, or any liquid material on the soil surface five hours after the application has ceased. Applications of both liquid and non-liquid materials should be avoided when soils are wet, when rain is imminent, and in places where the runoff risk is high. Note that dry soil-conditioner material can be transported long distances with runoff.

8.19 ***The material cannot contain any human or animal pathogens (harmful bacteria, diseases, etc.), or any hazardous substances***: This requirement applies mainly to biosolids. Raw sewages can contain high risk levels of microbial pathogens, heavy metals and chemical contaminants. They need to be treated and refined before they can be used safely for agricultural purposes. The degree of treatment and refinement is expressed by quality grading. Only Aa grade accredited biosolids can be applied to land under a FARM Strategy resource consent. This grade is deemed of sufficiently high quality that the biosolid *can be safely handled by the public and applied to land* [at appropriate rates] *without risk of significant adverse effects* (NZWWA 2003).

8.20 ***The material cannot be applied within***:

- ***50 m of the property boundary.***

- ***20 m of surface water, bores, or the Coastal Marine Area.***
- ***50 m of ecological or archaeological areas.***
- ***150 m of public areas or residential plots.***

Separation distances for the application of biosolids and soil are measured from the edge of the spread pattern (see Figure 5). Alternative separation distances may be considered for certain soil conditioners (e.g. lime) if effects will likely be minor. Contact the Consents Team on freephone 0508 800 800 for more information.

8.21 ***Stock must be physically prevented from entering waterways and waterbodies at all times***: The primary purpose of this requirement to minimise the risk of faecal contamination to surface water, both from direct deposition of stock excreta to the water itself, and from depositions onto banks and verges that may be readily washed into surface water with runoff. Faecal contamination of surface water is a serious health risk (contaminants can include *Campylobacter*, *Cryptosporidium*, *Giardia*, pathogenic *E. coli*, and Salmonellae) for both humans and livestock. For the definitions of Waterways and Waterbodies refer to Figure 3.

8.22 ***All locations where stock cross waterways must be bridged or culverted***: This requirement applies only to waterways that flow all year around. Purpose is to minimise stock excretion directly to water and the associated risks of faecal contamination (see $8._{21}$). Please contact the Consents Team if you have a crossing that may be unsafe or unsuitable for a culvert or bridge (freephone 0508 800 800).

New culverts and bridges can be constructed as part of a FARM Strategy if they are built according to design criteria (Figure 6), and provided the culvert or bridge will not impact on neighbours, flood and erosion schemes, or fish passage. Refer to Rules 16-11 and 16-12 of the proposed One Plan for further detail.

Figure 7: *Design criteria* for new culverts and bridges (from Rules 16-11 and 16-12).

Culverts

- Only one culvert per crossing.
- Maximum length = 20 m.
- Diameter must be between 0.3 m to 1.2 m.
- All practicable steps are taken to minimise the release of sediment during construction.
- Minimum installation depth below the bed of 0.3 m or 20% of the culvert width, whichever is lesser.
- The culvert will be able to withstand a 1-in-20 year flooding event without overtopping, unless the overtopping flows to a specifically designed spillway.
- The inlet and outlet are protected against erosion.
- Maximum fill height above the culvert = 2 m.
- The culvert is kept clear of accumulated debris.
- The culvert is built and maintained to avoid erosion or degradation of the bed.
- Culvert alignment and gradient must be the same as the waterway.
- The culvert will not impede the rate of flow experienced during a 1-in-2 year flooding event (e.g. will not cause damming).

Bridges

- Catchment size above the bridge must be < 200 ha.
- Bridge foundations must not occupy a bed area > 20 m^2.
- The bridge must be built and maintained in a way to avoid any aggradation or scouring of the bed that may inhibit fish passage.

New culverts or bridges that cannot meet these *design criteria* will need separate resource consent. Also note there are other criteria that require consideration (impact on neighbours, flood/erosion schemes, or significant waterways). Please refer to Rules 16-11 and 16-12 or contact the Consents Team on freephone 0508 800 800.

8.23 ***Runoff from bridges, culverts, tracks and laneways, must not discharge directly to waterways or waterbodies***: These features tend to combine hard surfaces and elevated stock volumes. If they occur at low points or along sloping areas, there is a particularly high risk that any surface material (sediment, dung, urine) will be washed into the waterway.

Ideally bridges and culverts should be raised, and have a lip (raised edges) along the side of the bridge or culvert crossing. This will ensure that runoff is captured and channelled away from the waterway, usually back along the track where it can be discharged to land.

If this is not possible – for example the bridge or culvert is located at a low point or in a depression - then every effort should be made to manage runoff flowing from the track or raceway. This may include 'crowning' tracks so they have surface curvature that directs runoff to the side rather than flowing down the track. Humps or hollows can be built across the track to intercept runoff and discharge it to land. Ditches and channels alongside tracks should be directed to flow to land at frequent intervals.

8.24 ***Runoff from stock yards, dairy sheds, feed pads, holding areas, or any other stock concentration zone must not discharge directly to waterways or waterbodies***: This requirement aims to cover any situation not covered by 8.$_{1}$, 8.$_{12}$, or 8.$_{23}$, where stock densities and site characteristics may contribute to an elevated risk of runoff and contaminants reaching surface water. Such sites will need to be managed in a way that removes or minimises the risk.

8.25 ***Fertiliser must not be applied or discharged to waterways or waterbodies (including groundwater)***: A map of waterways and waterbodies should be made available to fertiliser (and effluent) spreaders. Likewise, define your own separation distances to ensure fertiliser is not applied to water.

8.26 ***Fertiliser must not be applied or discharged into any ecological area (except for the pre-approved purpose of enhancing such areas)***: Ecological areas are defined as rare and threatened habitats, and at-risk habitats. In practical terms these are areas of bush, wetlands and riparian zones that are recognised as having important natural or ecological values. A list of recognised ecological areas is available as Schedule E in the proposed One Plan (http://www.horizons.govt.nz/default.aspx?pageid=170).

Fertiliser is not to be applied directly or indirectly into these recognised ecological areas. A rare exception is when fertiliser is used to enhance the area (e.g. establishing new native trees). Contact the Consents Team for further information on freephone 0508 800 800.

8.27 ***The fertiliser must be applied in accordance with the Code of Practice for Fertiliser Use***: This publication (FertResearch, 2007) provides industry standards for optimal fertiliser use and best practices for minimising environmental impacts (see http://fertresearch.spitfirecreative.net).

8.28 ***Nitrogen fertiliser applications must be managed with a nutrient budget that accounts for other N-sources and minimises N-leaching risks***: Refer to Section 6.

8.29 ***The application of any fertiliser will not result in any objectionable odour or problem-causing drift beyond the farm boundary***: This should also apply to any residences located on the farm. Bulk fertiliser dressings by ground or aerial spreaders are of most concern. Trusted contractors should be made fully aware of this requirement before making applications (but note that responsibility still rests with the consent holder). It is also good practice to forewarn neighbours on days when bulk fertiliser is to be applied.

8.30 ***EITHER, up to 30 m^3/day can be extracted for domestic purposes and stock drinking water, OR up to 15 m^3/day can be extracted for other purposes. These two allowances cannot be added together***: Minor surface water takes are permitted under a FARM Strategy resource consent. Refer to Figure 10 in Section 10 to estimate daily water demand. The take can only be used for the property that the consent applies to (as described in Section 2), and there is a limit on daily volumes determined by use. **Only one of the following options can be selected**:

- *General farm use*: Up to **15 m^3/day** can be extracted for general farming purposes such as domestic water supply, stock water, small-scale irrigation, cleaning machinery and vehicles, food processing (e.g. vegetables), milk cooling, and other forms of plant or shed water (e.g. cleaning, yard washdown).
- *Domestic supply and stock water only*: Up to **30 m^3/day** can be extracted for *reasonable* domestic uses and to supply *reasonable* volumes of stock drinking water. Note that this option excludes plant and shed water (for milk cooling, vegetable processing, washing down yards, etc.).

The two allowances cannot be added together. Only one option can be selected. Dairy operations on a single surface-water take and running more than 200 cows are unlikely to qualify for either option, and may need to apply for a separate surface-water resource consent (see $8._{42}$) or supplement water supply from groundwater (see $8._{36}$).

8.31 ***The rate of take must not exceed 0.5 litres per second (30 litres per minute)***: This maximum rate seeks to minimise the risk of several abstractors (using the same water source) drawing too much water too quickly. This requirement is best checked by an irrigation specialist.

8.32 ***Intake velocity must not exceed 0.3 metres per second***: This is the speed of water entering the intake. For the same amount of water drawn, small diameter intakes will have a much faster rate than large diameter intakes. A velocity of 0.3 m/s is based on the average swimming capabilities of NZ fish species (i.e. most fish shouldn't be drawn into the intake because they can swim faster than 0.3 m/s). Intake velocity is best checked by an irrigation specialist.

8.33 ***The intake must be covered with a mesh or screen. Diameter of holesin the mesh or screen must be no greater than 3 mm***: A screen or mesh decreases the amount of debris entering the irrigator system. A diameter size of 3 mm is used to minimise the risk of juvenile trout and other fish species being sucked into the intake.

8.34 ***The take must not be from a wetland that is an ecological area of importance***: Wetlands by definition are permanently saturated. Such conditions provide a special habitat for certain plant and animal species. A water take can result in fluctuating water levels and water-tables, which is considered to have an adverse effect on such habitats. Refer to $8._{26}$ for an explanation of ecological areas.

8.35 ***Written notification must be supplied regarding take location, intended use of the water, and the maximum instantaneous rate of take***: Please refer to Section 10.

8.36 ***The rate of take must not exceed 50 m^3 per day***: Minor ground water takes up to 50 m^3/day are permitted as part of a FARM Strategy consent provided the extracted water is only used for the property to which the consent applies (as described in Section 2). Takes can be used for general farm purposes depending on quality (e.g. domestic supply, small scale irrigation, plant and shed water, yard wash down). Groundwater takes >50 m^3 per day require a separate resource consent application (see One Plan rule 15-8).

8.37 ***The bore must not be located within 50 m of any other bore, unless written approval from the bore owner has been obtained***: This requirement aims to avoid the possibility of new bores lowering the water table of existing bores (thereby necessitating reboring of existing bores to greater depths). This requirement can be offset if written permission can be obtained from the neighbouring bore owner(s).

8.38 ***The take must not lower the water level in any wetland that is an important ecological area***: Refer to $8._{34}$ for an explanation.

8.39 ***The bore must be installed with a means of controlling the rate of flow (where the bore would otherwise be free-flowing)***: Control is required to regulate abstraction rates and to ensure water is not wasted.

8.40 ***Water must be used efficiently; no water is allowed to run to waste***: Water is a valuable resource. There should be no appreciable leaks anywhere along the abstraction or delivery system. Even a small leak can waste large volumes of water (Figure 7). Likewise, how the water is used should be managed in such a way that avoids unnecessary wastage.

8.41 ***Written notification must be supplied regarding take location, intended use of the water, and the maximum instantaneous rate of take***: Please refer to Section 10.

8.42 Major surface water takes. Surface water takes >30 m^3 per day are controlled activities. Please refer to Section 11 if you would like to apply for a major surface water take.

8.43 *No help required*.

8.44 *No help required*.

8.45 *No help required*.

Figure 8: Small leaks… big losses

Leak this size	Loss per hour (litres/hr)	Loss per day (litres/day)	Loss per year (litres/year)
	23	550	200,750
	68	1,640	598,600
	131	3,150	1,149,750
	227	5,455	1,991,075
	364	8,730	3,186,450
	586	14,070	5,135,550
	814	19,530	7,128,450
	1,258	30,185	11,017,525
	1,323	31,750	11,588,750
	1,596	38,300	13,979,500

Small leaks in water lines under pressure can lead to big losses over time (see table opposite). A leak the size of a small nail could be losing upwards of 14,000 litres per day (14 m^3/d), which will quickly deplete any allocation if left unrepaired (adapted from Stewart & Rout 2007).

A seemingly insignificant drip can also result in substantial losses (table below), particularly if pipes and fittings have many such leaks.

Drips per minute	Water loss	
	Litres/day	Litres/year
1	0.5	199
5	2.7	995
10	5.5	1,989
50	27.3	9,946
100	54.5	19,893
200	109.0	39,785
300	163.5	59,678

Section 9: Supplementary information for farm effluent.

9 The storage and application of farm effluent to land is a controlled activity. Recognised sources of farm effluent include:

1. Effluent from dairy sheds and yards.
2. Effluent from feed pads and other feeding out areas (as described in 8.$_{11}$).
3. Sludge from effluent ponds.
4. Effluent from pig operations.
5. Effluent and litter from poultry operations.
6. Effluent leachate from bulk supplementary feeds (as described in 8.$_{11}$).

7. All other areas where effluent may accumulate (e.g. stock underpasses).

Animal effluent is defined as dung and urine from animals (not people). Farm effluent is defined more broadly to include animal effluent plus waste liquid (e.g. silage leachate, pit washings, milk, milk residue, molasses, detergents, rainwater, stormwater, runoff, etc.) or solid wastes flushed from hard areas (e.g. sediment, soil, waste supplementary feed, fertiliser, etc). For dairy farms this is often referred to as Farm Dairy Effluent (FDE).

Human effluent waste is excluded. Under no circumstances should human waste be mixed with farm effluent. Such waste requires special treatment to achieve certain quality standards before it can be applied to land (see biosolids Section 8.$_{19}$). Similarly dead animals or dead animal material (e.g. offal) must not be added to the effluent system. Both can pose serious health issues.

The purpose of Section 9 is to provide Council with sufficient information regarding the volume of effluent produced, storage capacity, and details regarding land application. Emphasis is on effluent produced by dairy farming operations AND the bulk storage of silage. Contact the Consents Team if the farming operation also includes commercial poultry or pig production, or uncommon effluent situations (freephone 0508 800 800).

9.1 Milking information.

Milking herd size: Peak season cow numbers.

Average milking time: Number of hours per milking that cows are in the milking shed (peak season).

Milkings per day: Tick either once or twice per day to indicate milking frequency during peak season.

Milking shed water consumption: Refer to Figure 10 to help estimate the volume of water used in the milking shed during peak season.

Season start/end: Enter when the milking season starts and finishes.

Milking information is used to calculate the volume of effluent generated from the milking shed. You can estimate this yourself using the following equations:

$$\underset{\text{Average liveweight (kg per cow)}}{\boxed{}} \times \underset{\text{Liveweight ratio}}{0.11} \div \underset{\text{Hours of activity}}{16} \div \underset{\text{Convert to cubic metres}}{1000} = \underset{\text{Dung/urine per cow } (m^3/cow/hr)}{\boxed{}}$$

$$\underset{\text{Dung/urine per cow } (m^3/cow/hr)}{\boxed{}} \times \underset{\text{Herd size (number of cows)}}{\boxed{}} \times \underset{\text{Milking time (hours per milking)}}{\boxed{}} \times \underset{\text{Milkings per day}}{\boxed{}} = \underset{\text{Shed dung/urine } (m^3/day)}{\boxed{}}$$

$$\left(\underset{\text{Shed dung/urine } (m^3/day)}{\boxed{}} + \underset{\text{Water consumption } (m^3/day)}{\boxed{}}\right) \times \underset{\text{Length of season (number of days)}}{\boxed{}} = \underset{\text{Shed effluent } (m^3/yr)}{\boxed{}}$$

(excludes stormwater)

9.2 Pad information.

Days of use per month: Indicate the approximate number of days that the pad is used each month. For example, a pad might be used everyday during the milking season for regular feeding, but only a couple of days a month during the off season to spell wet pastures.

Number of cows per day: Indicate the daily average number of cows using the pad for any given month.

Duration (hours per day): Indicate how many hours per day the stock are using the pad. For a regularly used feedpad this may be only a short period (e.g. 0.5 – 1 hr/day), while a wintering pad may have far longer durations (e.g. 8 hrs per day).

	Days of use per month		*Number of cows*		*Duration (hrs/day)*		*Dung/urine per cow (m^3/cow/hr)*		*Monthly totals (m^3/month)*
Jan		x		x		x		=	
Feb		x		x		x		=	
Mar		x		x		x		=	
Apr		x		x		x		=	
May		x		x		x		=	
Jun		x		x		x		=	
Jul		x		x		x		=	
Aug		x		x		x		=	
Sep		x		x		x		=	
Oct		x		x		x		=	
Nov		x		x		x		=	
Dec		x		x		x		=	
							Pad effluent production (m^3/yr)		

(excludes stormwater)

Degree of pad use is used to estimate the volume of effluent generated. It is assumed that all pad effluent enters the main effluent system and will be applied to land via irrigator. If this is not the case, please describe how pad effluent is managed.

To make your own estimate, multiply each row by effluent yield per cow (from 9.1), and then add up all monthly totals.

9.3 Leachate from stored feed. Indicate the volume of leachate collected from supplementary feed stored on hard surfaces (namely bulk silage). If leachate is not collected, then leave this section blank (however check requirement $8._{11}$).

If silage leachate is collected into the main effluent system: Leachate production from stored silage can be estimated from silage quantity and quality. Multiply silage tonnage by leachate production levels (Table 4). These figures may also be tentatively used for maize silage. Figures exclude rainfall contributions (e.g. extra leachate produced because silage is not covered, or stormwater runoff from the cover and storage area).

Table 4: Leachate production from grass silage

Silage preparation technique	**Volume of leachate per tonne of silage (m^3/tn)**
Pasture ensiled without any wilting	0.5
Pasture wilted to 20% dry matter before ensiling	0.085 (range 0.05 – 0.12)
Pasture wilted to 25% dry matter before ensiling	0.03

From DEC 2006b

If leachate is collected in a separate sump or pond: Measure the volume of stored leachate before emptying (length x width x depth = volume), and multiply by the number of times the sump or pond is emptied each year.

9.4 Effluent application area.

Effective area: This is the actual area that effluent is applied by the irrigator, as determined by spread pattern and coverage. Irrigator spread diameters may be obtained from irrigator manufacturers, or measured during operation. Formulas to help with the calculation of area are included as Figure 9.

Natural soil drainage: The original soil drainage status as determined by soil colour and mottling. This can be obtained from soil maps or farm LUC survey (see Section $3._1$). Alternatively, dig a hole and examine the soil yourself (Figure 8). Note that *moderately well drained* and *imperfectly drained* categories used in soil mapping are combined here as *soils with impeded drainage*.

Artificial drainage: Refers primarily to subsurface drainage such as mole, tile, novaflow, etc.

Topography: Refers to the dominant slope or topography type within the effluent application area.

Dominant soil type: Refers to the texture of the topsoil or the primary parent material (pumice, peat). This can be obtained from soil maps (e.g. Dannevirke *silt loam*) or farm LUC survey (see Section 3.$_1$).

Figure 9: Natural soil drainage conditions

Natural soil drainage conditions are defined by the depth of gleying and mottling. Gleying is when part of the soil profile is noticeably grey in colour (indicates long term water logging). Mottling is blotches of bright rusty colours (orange, red, yellow, brown) that indicate a fluctuating water table (short term water logging). Mottling and gleying often occur together.

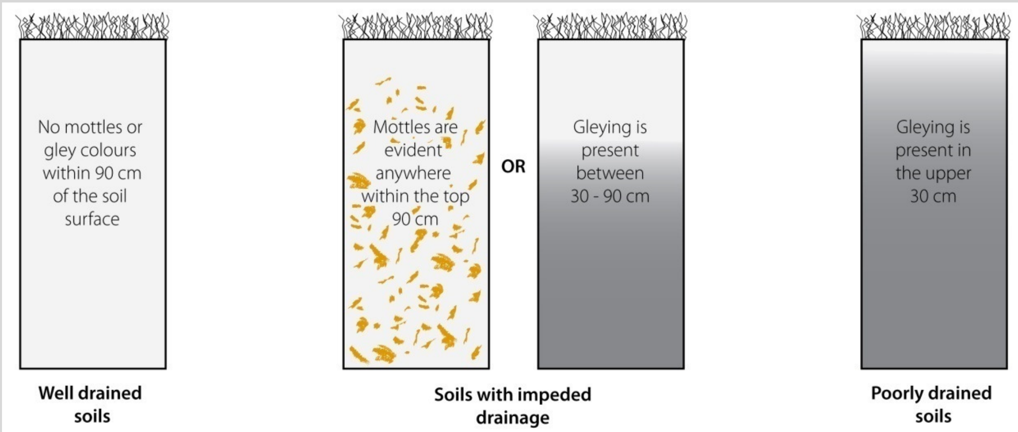


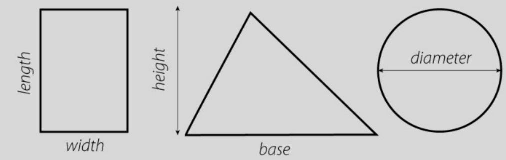
Figure 10: Calculating surface areas and storage volumes

1. Surface area of regular shapes

Area of a rectangle or square = length x width

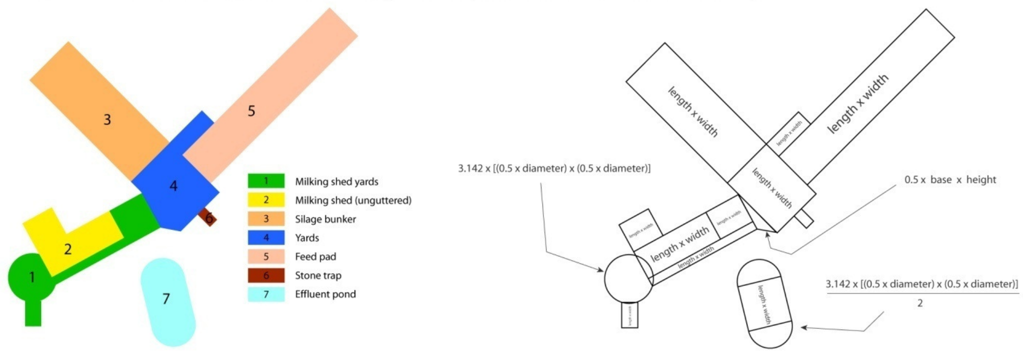
Area of a triangle = 0.5 x base x height

Area of a circle = 3.142 x [(0.5 x diameter) x (0.5 x diameter)]



2. Surface area of compound shapes

Most farm infrastructure can be broken down into general shapes to calculate surface area. For example:

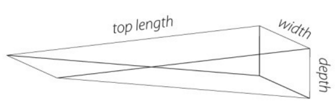


3. Surface area of irregular shapes (polygons)

The surface area of irregular shapes (e.g. some effluent ponds) can be calculated using farm mapping software if a sufficiently detailed aerial photo is available. Alternatively, an estimate can be made using the 'compound shapes' technique described above.

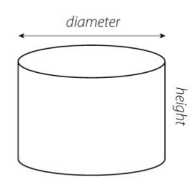
4. Volume of common farm storage facillities

Wedge shaped stone traps



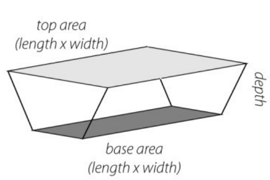
Volume = 0.5 x top length x depth x width

Storage tanks



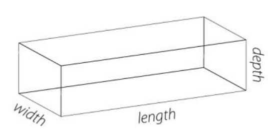
Volume = 3.142 x [(0.5 x diameter) x (0.5 x diameter)] x height

Effluent ponds with batter slopes



$$\text{Volume} = \left[\left(\text{top area} + \text{base area}\right) + \sqrt{\left(\text{top area} \times \text{base area}\right)}\right] \times \text{pond depth} \div 3$$

Rectangular sumps and bunkers



Volume = length x width x depth

Note: Make ensure all calculations use units of metres. For example, volume (m^3) = length (m) x width (m) x depth (m).

9.5 Effluent storage areas. Purpose is to calculate total surface area and total effluent storage capacity.

Surface area: This is used to calculate rainfall contributions (and evaporation losses) to the storage areas. Farm mapping software or the professional services of a surveyor may be required to calculate irregular shaped areas (e.g. some ponds). Regular shapes can be measured with tape or a measuring wheel.

Storage capacity: If storage capacity is not already known, it can be calculated using the volume formulas in Figure 9. Add together to calculate total effluent storage capacity for your farm. A surveyor may be required to calculate volumes for irregular shaped ponds with variable depths.

Desludged once every… Indicate the frequency of desludging. Leave blank if never desludged (e.g. mechanical stirrer is used).

Pumped to the irrigator? Indicate which sources are pumped directly to the irrigator.

9.6 Stormwater catchment areas and diversion.

Surface area: Use the formulas in Figure 9 to help calculate the area of various stormwater collection surfaces. Only include surfaces that contribute to effluent production (i.e. flow to sumps or ponds).

Tick if stormwater diversion installed: Tick this option if an adjustable stormwater system is installed (e.g. Y valves, diversion gates, etc.).

Months when stormwater diversion is active: If a stormwater diversion system is installed, tick the months for which it is being used (i.e. when stormwater is being diverted away from effluent storage).

9.7 Effluent application details.

Irrigator type: If possible list the manufacturer name and model. If not, then record the general type of irrigator (e.g. gun, travelling irrigator, etc.).

Application depths by month: Application depth is the height of liquid effluent applied to any part of the paddock during irrigation. This information can be obtained from:

1. Irrigator manufacturers. Contact your irrigator manufacturer or refer to the original user manual. They will be able to translate irrigator speed settings into application depths. Generic values for travelling irrigators include FAST (<12 mm depth), MEDIUM (12 – 24 mm) and SLOW (>24 mm). However, there is much variability between different irrigator makes and models.
2. Measurement using collection containers. Place collection containers beneath the irrigator spread at 2 metre intervals. Measure the depth of effluent that each container collects, and work out the average depth of application (add all the measures together then divide by the number of containers).

Average volume of effluent applied per day: Indicate the average daily volume of effluent applied for each month. This can be estimated by:

1. Pumping information.

Pumping rate (m^3/hr)		*Irrigation duration (hrs/day)*		*Daily volume (m^3/day)*
	x		**=**	

2. Application depth and coverage.

Application depth (mm)		*Convert to metres (m)*		*Length of run (m)*		*Width of run (m)*		*Number of runs per day*		*Daily volume (m^3/day)*
	x	0.001	**x**		**x**		**x**		**=**	

Section 10: Supplementary information for MINOR water takes.

10 Section 10: Supplementary information for MINOR water takes. Complete this section if you require a minor ground or surface water take (see $8._{30}$ or $8._{36}$).

10.1 Ensure that each extraction site is marked on the Property Map (Section 3). This includes bore sites and surface water intake sites. Number each extraction site.

10.2 Fill in the table.

Your map reference: Enter the number from the Property Map that references the extraction site.

Type of take: Indicate if the take is *surface* or *groundwater*.

Intended use of extracted water: Indicate how the water will be used. Choose one or more options from the list below:

- Stock water
- Irrigation
- Domestic supply
- Dairy shed water (including washdown and cooling water)
- Other – please specify

Peak daily demand (m^3/day): This is the maximum volume of water that will be extracted during periods of peak usage (e.g. during the milking season, when irrigating, etc.). Figure 10 can be used to estimate water demand for common farm purposes, but it is strongly recommended that larger takes are based on a more comprehensive investigation (e.g. irrigation requirements from a soil water balance prepared by an irrigation specialist).

Compare your estimate for peak daily demand to the volumes permitted for minor water takes:

- Surface takes up to 15 m^3 are permitted for general farming purposes (refer to $8._{30}$).
- Surface takes up to 30 m^3 are permitted if the water will only be used for domestic supply and/or stock water (refer to $8._{30}$).
- Groundwater takes up to 50 m^3 are permitted for general farming purposes (refer to $8._{36}$).

If your water requirements cannot be met by a minor surface water take, consider installing a bore or apply for a major surface water take (refer to $8._{42}$).

10.3 Optional supporting information. You may be able provide information to support your estimate of peak daily water demand, such as a letter of confirmation from a recognised technical specialist, or evidence of measured data or monitoring records.

Please note that it is illegal to intentionally provide false or misleading information. Council will look closely at applications if peak daily demand estimates are:

- **Outside common ranges for the given farming type or intended water use.**
- **Are close to the permitted daily volumes.**
- **Do not fully reconcile with other information provided as part of the consent application.**

Figure 11: Water take estimator

1. Estimate domestic water use

Number of farm households to be supplied

	People per household		Guideline (m^3/person/day)		Volume required (m^3/day)
Household #1		x	0.3	=	
Household #2		x	0.3	=	
Household #3		x	0.3	=	
				Total A	

1. Use another sheet of paper if there are more than three households on the property.

2. 'People per household' refers to permanent residents and includes children.

3. The guideline is based on 300 litres per person per day (covers inside and outside water use).

2. Estimate peak stock-water requirements

	Enter stock numbers		Animal demand (m^3/head/day)		Volume required (m^3/day)
Milking cows		x	0.07	=	
Dairy dry stock (>1yr)		x	0.045	=	
Beef cattle (>1yr)		x	0.055	=	
Ewes, hoggets & rams		x	0.0045	=	
Deer (all ages)		x	0.012	=	
Working horses		x	0.07	=	
Grazing horses		x	0.05	=	
				Total B	

4. Water demand conversion-factors taken from Stewart & Rout, 2007. They are based on peak demand (water demand during the driest months).

5. Contact the Consents Team if your operation also includes sizeable numbers of goats, poultry or other animals (ph. 0508 800 800).

3. Estimate irrigation requirements

Area to be irrigated (m^2)		Peak rate (m^3/m^2/day)		Volume required (m^3/day)
	x	0.005	=	
				Total C

6. The estimate will only be a crude approximation at best. Council expects a far more detailed analysis if the irrigation area is >500 m^2.

7. The peak rate is a commonly-used design value of 5 mm.

4. Estimate dairy shed water consumption (3 options)

Option 1: Known consumption from meter or other measurement.

Water use per milking (m^3)		Number of milkings per day		Volume used (m^3/day)
	x		=	

Option 2: Change in tank level

(Water in tank at milking start (m^3)		Water in tank at milking end (m^3))		Number of milkings per day		Volume used (m^3/day)
	–		x		=	

Option 3: Design estimate

Peak cow numbers		Number of milkings per day		Design value (m^3/cow)		Volume used (m^3/day)
	x		x	0.045	=	

Best estimate for dairy shed consumption =

Total D

8. Multiply litres by 0.001 to convert to cubic metres.

9. Multiple gallons by 0.0037854 to convert to cubic metres.

10. Option 3 uses a conservative design value of 45 litres/cow. Shed water consumption may vary between 20 to 65 litres/cow depending on water use efficiency.

5. Add together Totals A, B, C and D plus any other substantial water uses not listed. The grand total is an estimate of the peak daily water demand for the farm.

Grand Total *m^3/day*

Section 11: Supplementary information for MAJOR surface water takes.

11 Section 11: Supplementary information for MAJOR surface water takes. Major surface takes are a controlled activity treated on a case-by-case basis according to Rule 15-5.

- The take cannot be from a protected river.
- Water cannot be extracted during times of minimum flow.
- Takes are based on a system of core allocation limits.
- There is a cap on the total volume of water available in each catchment.
- The take cannot lower water levels of wetlands that have ecological importance.

Council will undertake the procedures and calculations necessary to determine allowable volumes and the specific management requirements of each requested take.

11.1 What will the water be used for? Tick one of more options and fill in the required details.

Water source: Put in the actual name of the water source (e.g. *Tamaki River*). If unnamed, then indicate the name of the parent source (e.g. *unnamed tributary of the Tamaki River*).

Maximum volume required per day: An approximation of water demand for different uses can be made using Figure 10. However, for major surface takes Council expects a far more considered analysis of likely water demand, especially in regard to irrigation.

Type of irrigator: Ideally provide the model and make, and indicate the general type (see DEC 2006b for more information):

- Sprinklers (e.g. k-line) or laterals
- Soft hose travelling gun irrigator
- Hard hose travelling gun irrigator
- Travelling boom irrigator
- Centre pivot
- Flood system (e.g. border dyke)

Flow meters: A flow meter is used to monitor and check the volume of water extracted. All major surface water takes are expected to have a flow meter. For more information contact the Hydrology Team on 0508 446 749, or download the *Choosing a Flowmeter* information brochure (www.horizons.govt.nz/Images/Publications/ResourceManagement/Chossingaflowmeter.pdf).

Telemetry systems: Telemetry is an electronic way of automatically transferring monitoring data using cell-phone technology. It removes the need for manual recording and reporting. Telemetry systems are optional, but encouraged for those who may wish to simplify water take recording and reporting. Contact the Hydrology Team for more information.

11.2 Neighbouring water takes. Any new water take may impact on existing water takes. Please name the people who have existing water takes within approximately 1 km upstream and downstream of your take site.

Section 12: Final details.

12 Section 12: Final details.

12.1 Please indicate the support material that will be attached with the consent application.

12.2 A deposit must accompany an application when lodged, or your application will not be processed. FARM Strategy resource consent applications require a **$787.50** deposit (includes GST). Refer to the fees and charges web page for the full list of fees (www.horizons.govt.nz/default.aspx?pageid=75).

12.3 Sign and date the application.

INDEX OF TABLES AND FIGURES

Figures

Tables

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APPENDIX 1: SERVICE PROVIDERS

The following list is provided solely as a guide. The Council does not endorse or recommend any particular service provider. However, note that a nutrient budget must be prepared by an accredited operator, and the Council will only accept farm Land Use Capability (LUC) mapping undertaken by experienced or qualified surveyors (as recognized by the Council in the list below).

- (green) LUC map provider (for a farm LUC map based on regional data).
- (red) Council recognised LUC surveyor (for new farm surveys)
- (blue) Accredited Overseer® Nutrient Budgets operator

Providers who would like to appear on this list should contact the Horizons consent team on 0508 800 800.

	Organisation	Contact	Address
(green) (red) (blue)	Landvision	Lachie Grant lachie.grant@gmail.com Sarah Dudin sarah.dudin@gmail.com	PO Box 177 Stratford Ph. 06 753 6464 Mb. 021 526 478 www.landvision.co.nz/
(blue)	Baker and Associates Ltd.	Chris Lewis chrisl@bakerag.co.nz	Baker and Associates Ltd PO Box 900, Tranzit Building 316 Queen Street, MASTERTON Ph Cell: 027 446 0294
(red)	Terry Crippen	Terry Crippen terry_crippen@clear.net.nz	11 Pahiatua Street Palmerston North Ph. 06 356 3588
(green) (red) (blue)	Soil Suitability Assessments	Sharn Hainsworth soilmap@paradise.net.nz	35 Taitua Street Taumarunui Ph. 07 8958577 Mb. 021 288 0004
(blue)			

This appendix is provided as a suggested template for Horizons. It cannot be completed until a decision is made regarding how the Council may 'accredit' providers. It is recommended that a database of preferred/accredited suppliers be constructed, and an output list appended to the Reference Guide (i.e. replaces this appendix).

FARM Strategy consent application

A.1 This form is a combined workbook and consent application for a FARM Strategy consent.

A.2 Please refer to the accompanying FARMS Reference Guide throughout. Important information is provided for each number (A.1, A.2, etc).

A.3 Providing incomplete or intentionally falsified information may result in a declined application or worse. Applicants are encouraged to seek clarification or assistance if unsure about how to respond to any part of this form (see Reference Guide section A.3).

1. Applicant information

1.1 Who will be the **consent holder**? (also referred to 'the applicant')

Name: ______________________

Contact person: ______________________

Postal address: ______________________

Phone contact: ______________ Best contact time (8am to 5pm): ______________

Email: ______________ Fax number: ______________

1.2 Who will be making the consent application? (if different from the consent holder, e.g. a consultant)

Company name: ______________________

Contact person: ______________________

Postal address: ______________________

Phone contact: ______________ Best contact time (8am to 5pm): ______________

Email: ______________ Fax number: ______________

1.3 Please provide the **consent number** of any existing resource consents.

____

____

____

1.4 Do you agree to surrender these consents should the FARM Strategy consent application be granted? (please tick one).

○ YES

○ NO

2. Property details

2.1 Physical address ______________________

____

____

2.2 Legal description ______________________

____

____

2.3 Farming type (please tick one)

○ new conversion ○ sheep/beef ○ cropping

○ dairy ○ commercial vegetable growing

2.4 Rates Valuation Number

_ _ _ _ _ / _ _ _ . _ _

2.5 Dairy supply number (if relevant)

_ _ _ _ _ _

2.6 Total farm area ________ ha

2.7 FARMS catchment: ______________

____

2.8 Date that Rule 13.1 comes into effect:

01/04/20 _ _

Page 01

3. Farm maps

3.1 Please attach a Land Use Capability (LUC) map of the farm. See the Reference Guide for more information.

3.2 Please attach an accurate **property map** of the farm and the immediate surrounding area (out to 250m). The Council is interested in the location of Rule 13.1 activities, and their separation distances between public, private, and ecological sites of interest. Please record the following:

- Farm boundary
- Feed storage areas
- Bores and water-takes
- Effluent block
- Effluent pond or sump
- Public roads
- Residential plots
- Public areas[1]
- Ecological areas[1]
- Archaeological sites[1]
- Waterways[1]
- Waterbodies[1]
- Unbridged or un-culverted stock crossings of waterways
- The Coastal Marine Area[1]

[1] *See the Reference Guide glossary for full definitions*

4. Calculate farm N-caps

4.1 Enter the area in hectares of each **LUC Class** in the first column of the table below.

4.2 Enter the **Reference N-cap** in the second column for each LUC Class. These are listed in the Reference Guide (see 4.2). First time FARMS consent applications should use Year 1 values.

4.3 Multiply columns A and B, and enter the result in column C.

4.4 Add up all the values in Column A (the total should equal total farm area).

4.5 Add up all the values in column C. The total is the maximum amount of nitrogen that can be leached from your entire farm.

LUC Class	A. LUC areas *Enter the hectare area of each LUC Class*		B. Reference N-Caps *Refer to 4.2 of the Reference Guide*		C. Permitted N-leaching *Multiply column A by column B*	
I	ha	x		=		
II	ha	x		=		
III	ha	x		=		
IV	ha	x		=		
V	ha	x		=		
VI	ha	x		=		
VII	ha	x		=		
VIII	ha	x		=		
Totals 4a		ha		4b		kg N

4.6 Divide total permitted N-leaching (Box 4b) by total area (Box 4a). The result (Box 4c) is the maximum permitted amount of nitrogen that can be leached **per hectare**. This is the farm's N-cap.

4b ______ kg N ÷ 4a ______ ha = 4c ______ kg N/ha

Maximum N-leaching allowance for the whole farm — *Total farm area* — *This is the farm's N-Cap*

5. Assess current N-leaching

5.1 Have an Overseer® Nutrient Budget prepared for your farming operation by a certified operator. Ensure the budget is prepared using **total farm area**. Enter the Overseer® *nitrogen leaching/runoff* result for your farm in Box 5a.

5.2 Subtract the Overseer® N-leaching value (Box 5a) from the farm's N-cap (previous Box 4c).

5.3 If the difference is a positive number, then the N-cap balance is in credit, and no special N-mitigations are required (go to Step 7). If the difference is negative, then the N-cap balance is in deficit, and special N-mitigations are needed (go to Step 6).

4c	kg N/ha	–	5a	kg N/ha	=	5b	kg N/ha
Enter the farm's N-cap			*Subtract Overseer nitrogen leaching/runoff value*			*If 5b is a positive number, go on to Step 7 If 5b is a negative number, go on to Step 6*	

6. Managing N-cap deficits

6.1 Work with your Overseer® operator to identify options for reducing N-leaching losses. In being accredited, they will be familiar with the types and combinations of N-mitigations that will be most suitable and effective.

6.2 Enter the revised Overseer® *nitrogen leaching/runoff* result for the farm in Box 6a. The calculated difference (Box 6b) must equal zero or a positive number before continuing.

4c	kg N/ha	–	6a	kg N/ha	=	6b	kg N/ha
Enter the farm's N-cap			*Subtract the revised Overseer nitrogen leaching/runoff value*			*Box 6b must equal zero or be a positive number before you can continue*	

6.3 Please list and briefly describe the special N-mitigation practices that you will undertake to achieve your farm's N-cap. Be specific and use dates and quantities where possible. These will become conditions of the FARMS whole farm consent should it be granted. Use an extra sheet of paper if the space below is insufficient. Attach any extra sheets of paper to this application.

N-mitigation	Description
Example: Avoid winter urea	Maintain current urea policy (100 kg urea-N/ha/yr) but cease applications in May, June + July. Reduces Overseer N-leaching by 4 kg N/ha/yr.

Continue on an extra sheet of paper if required

7. Attach Overseer® reports

7.1 Please attach Overseer® output reports to this application (only the revised Overseer® results are needed for those who completed Step 6). Key reports of interest include: Nutrient budgets (for individual blocks and for the whole farm), and Nitrogen, Effluent, and Block Nitrogen reports.

Page 03

8. Compliance status checklist

The following checklist summarises Rule 13-1 compliance requirements that must be met before a FARM Strategy consent can be granted. Please assess Rule 13-1 compliance status for your farm by ticking the most appropriate option for each legal requirement.

Any requirement that is ticked as NEEDS ATTENTION or NOT SURE must be resolved before Rule 13-1 comes into effect for your catchment (refer to the date entered for question $2_{.8}$). Tickbox options include:

NA	=	Not applicable. Tick this option if the activity is not undertaken or practiced on the farm.
COMPLIANT	=	Tick this option if you are fully confident that the requirement is being achieved.
NEEDS ATTENTION	=	Tick this option if the requirement is not currently being achieved, and/or further work is neccessary to achieve full compliance.
NOT SURE	=	Tick this option if there is some uncertainity regarding compliance status. This is not unusual. Some requirements may require technical assessment to clarrify actual status.

The checklist is provided as a guide only. Wording has been adapted in some cases to provide context. Please refer to Chapters 13 and 15 if the proposed One Plan for the definitive descriptions that all consent applications are considered against.

Compliance checklist

Practice		Requirements	NA	COMPLIANT	NEEDS ATTENTION	NOT SURE
The storage and discharge of farm effluent[2].	$8_{.1}$	Effluent from <u>yards or pads</u> must not discharge directly to waterways or waterbodies (*including seasonally dry waterways or waterbodies*).	●	●	●	●
	$8_{.2}$	Effluent from <u>ponds or sumps</u> must not discharge directly to waterways or waterbodies (*including seasonally dry waterways or waterbodies*).	●	●	●	●
	$8_{.3}$	Stormwater must not discharge to effluent ponds, sumps, or any hard surface that drains into effluent ponds or sumps **UNLESS** adequate storage has been provided for.	●	●	●	●
	$8_{.4}$	Effluent ponds and sumps must be adequately sealed to avoid seepage and leaks.	●	●	●	●
	$8_{.5}$	Effluent ponds and sumps must have the capacity to store a minimum 7-days of effluent production in the event of equipment failure.	●	●	●	●
The application of farm effluent to land[2].	$8_{.6}$	Effluent irrigation pipes and equipment must not have any substantial leaks (e.g. causing local ponding).	●	●	●	●
	$8_{.7}$	A nutrient budget is required to help minimise the risk of elevated effluent-nitrogen loading.	●	●	●	●
	$8_{.8}$	Effluent applications must not be made on days when drift or odour is likely to affect neighbours.	●	●	●	●
	$8_{.9}$	There must be no significant surface ponding of applied effluent.	●	●	●	●
	$8_{.10}$	The area of land receiving effluent must not be located within: • *20 m of public areas, public roads, or residential plots.* • *20 m of surface water, bores, or the Coastal Marine Area.* • *50 m of ecological or archaeological areas.*	●	●	●	●

[2] The storage and application of farm effluent to land is a CONTROLLED activity that requires additional detail before the consent application will be considered by the Council. This additional information can be provided in Section 9.

Compliance checklist *continued*

Practice		Requirements	NA	COMPLIANT	NEEDS ATTENTION	NOT SURE
Storage and feeding of supplements.	8.11	**Feed storage areas** and **feeding-out sites** must be adequately sealed to avoid seepage and leaks. Hay storage is exempt. Small areas of silage storage are exempt if total area of unsealed pits and stacks per property is <500 m^2.				
	8.12	Runoff from **feed storage areas** or **feeding-out sites** must be prevented from entering waterways or waterbodies.				
	8.13	Runoff into **feed storage areas** or **feeding-out sites** must be prevented.				
	8.14	Effluent and leachate from **feeding-out sites** and **feed storage areas** must be managed as farm effluent (i.e. according to requirements 8.1 to 8.10)				
	8.15	The storage or feeding out of supplementary feed must not result in any objectionable odour, dust or drift beyond the farm boundary.				
	8.16	Supplementary feed must not be stored or fed-out at locations that are within: • *20 m of surface water, bores, or the Coastal Marine Area.* • *50 m of ecological or archaeological areas.*				
The application of biosolids[a] or soil conditioners[b] to land. [a] *Sewage or sludge that has been refined to an Aa grade.* [b] *Substances that alter soil physical qualities (e.g. lime, clay, gypsum, biochar, organic materials like compost, sawdust or bark).*	8.17	Biosolids or soil conditioners must not be applied or discharged to waterways or waterbodies.				
	8.18	There must be no significant surface ponding if the applied material is liquid, or any runoff into waterways or waterbodies (liquid or non-liquid).				
	8.19	The material cannot contain any human or animal pathogens (harmful bacteria, diseases, etc.), or any hazardous substances.				
	8.20	The material cannot be applied within: • *50 m of the property boundary* • *20 m of surface water, bores, or the Coastal Marine Area.* • *50 m of ecological or archaeological areas.* • *150 m of public areas or residential plots.*				
Preventing faecal contamination of water by stock, and from effluent runoff.	8.21	Stock must be physically prevented from entering waterways and waterbodies at all times[3].				
	8.22	All locations where stock cross waterways must be bridged or culverted.				
	8.23	Runoff from bridges, culverts, tracks and laneways, must not discharge directly to waterways or waterbodies.				
	8.24	Runoff from stock yards, dairy sheds, feed pads, holding areas, or any other stock concentration zone must not discharge directly to waterways or waterbodies.				

[3] Please refer to the Reference Guide Glossary for waterway and waterbody definitions. Permanent fencing is required for regularly flowing waterways. Intermittent waterways need only be fenced when flowing and accessible by stock.

Compliance checklist *continued*

Practice	Requirements		NA	COMPLIANT	NEEDS ATTENTION	NOT SURE
The application of fertiliser to farm land.	8_{25}	Fertiliser must not be applied or discharged to waterways or waterbodies (including groundwater).				
	8_{26}	Fertiliser must not be applied or discharged into any ecological area (except for the pre-approved purpose of enhancing such areas).				
	8_{27}	The fertiliser must be applied in accordance with the Code of Practice for Fertiliser Use.				
	8_{28}	Nitrogen fertiliser applications must be managed with a nutrient budget that accounts for other N-sources and minimises N-leaching risks.				
	8_{29}	The application of any fertiliser will not result in any objectionable odour or problem-causing drift beyond the farm boundary.				

Practice	Requirements		NA	COMPLIANT	NEEDS ATTENTION	NOT SURE
Minor surface water takes for on-farm use (up to 30 m^3 per day).	8_{30}	**EITHER**, up to 30 m^3/day can be extracted for domestic purposes and stock drinking water, **OR** up to 15 m^3/day can be extracted for other purposes. These two allowances cannot be added together.				
	8_{31}	The rate of take must not exceed 0.5 litres per second (30 litres per minute).				
	8_{32}	Intake velocity must not exceed 0.3 metres per second.				
	8_{33}	The intake must be covered with a mesh or screen. Diameter of holes in the mesh or screen must be no greater than 3 mm.				
	8_{34}	The take must not be from a wetland that is an ecological area of importance.				
	8_{35}	Written notification must be supplied regarding take location, intended use of the water, and the maximum instantaneous rate of take[4].				

4 This information can be provided in Section 10.

Practice	Requirements		NA	COMPLIANT	NEEDS ATTENTION	NOT SURE
Minor ground water takes for on-farm use (up to 50 m^3 per day)[5].	8_{36}	The rate of take must not exceed 50 m^3 per day.				
	8_{37}	The bore must not be located within 50 m of any other bore, unless written approval from the bore owner has been obtained.				
	8_{38}	The take must not lower the water level in any wetland that is an important ecological area.				
	8_{39}	The bore must be installed with a means of controlling the rate of flow (where the bore would otherwise be free-flowing).				
	8_{40}	Water must be used efficiently; no water is allowed to run to waste.				
	8_{41}	Written notification must be supplied regarding take location, intended use of the water, and the maximum instantaneous rate of take[4].				

4 This information can be provided in Section 10.
5 Groundwater takes >50m^3/day require a separate resource consent application (see Rule 15-8 in the proposed One Plan).

Practice	Requirements	
MAJOR surface water takes (greater than 30 m^3 per day).	8_{42}	Extracting surface water at volumes greater than 30 m^3 is a CONTROLLED activity. Specific and detailed information is required before Council will consider a consent application. This information can be provided in Section 11.

8.$_{43}$ This is the end of the compliance checklist. Please review those requirements ticked as NEEDS ATTENTION or NOT SURE. These items must be addressed before any FARM Strategy consent application will be considered by the Council.

Options available to help clarify or resolve yet unmet requirements include:

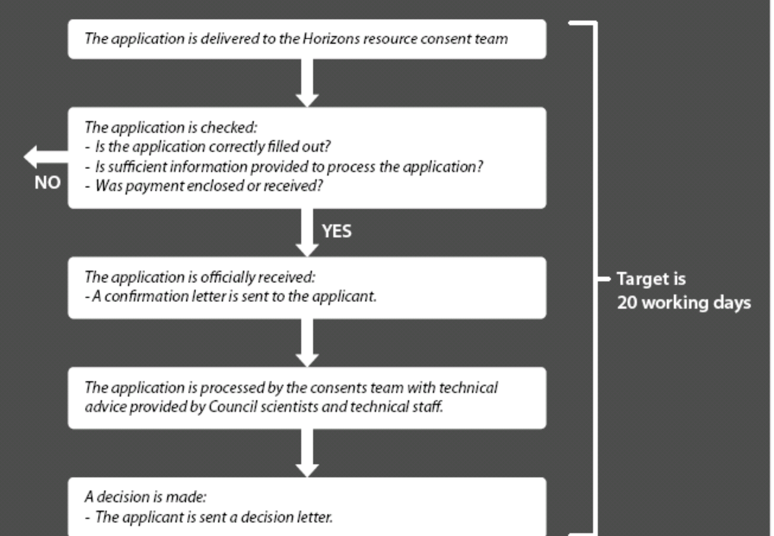
- Ring Horizons Regional Council's consents Team on freephone 0508 800 800 for questions or assistance regarding the consents process.
- Arrange to have a regional council officer undertake a site visit. Requests can be made by contacting the regional council on freephone 0508 800 800.
- Engage the services of an independent service provider. A list of providers recognised by the regional council has been included in the Reference Guide.

8.$_{44}$ If the consent application involves **water takes** or **effluent applications**, please complete the following sections:

- Section 9 if the consent application involves the storage and application of farm effluent to land (requirements 8.$_{1}$ to 8.$_{10}$).
- Section 10 if the consent application involves minor surface or groundwater takes (requirement 8.$_{30}$ or 8.$_{36}$).
- Section 11 if the consent application involves major surface water takes (requirement 8.$_{42}$).

8.$_{45}$ When all relevant consent requirements have been ticked as COMPLIANT, please complete this application by filling out and signing Section 12.

The FARM Strategy resource consent process



Information disclosure statement

The information requested in this form is required through the Resource Management Act 1991. Information that you provide will be used to process the FARM Strategy resource consent application. If the consent is granted, the information will also be used to monitor the exercise of the consent.

Horizons Regional Council may disclose the information if a request is made by another party, under provisions of the Local Government Official Information and Meetings Act 1987. Horizons Regional Council may also publicly disclose some of this information in circumstances where consent conditions have been breached.

Under the Privacy Act 1993, you have the right of access to personal information about you held by Horizons Regional Council and you are also entitled to request information about you to be corrected.

9. Supplementary information for farm effluent

Please complete this section if you store or apply farm effluent to land. Refer to the Reference Guide for help or clarification.

9.1 Milking information (for peak season).

Milking herd size: ______ cows

Average liveweight: ______ kg/cow

Average milking time: ______ hours per milking

Milkings per day (tick one): ○ Once per day ○ Twice per day

Season start: __ / __ / __

Milking shed water consumption: ______ m³/day

Season end: __ / __ / __

9.2 Pad information (feed pads, standing pads, wintering pads, etc.).

Estimated degree of pad use

	Days of use per month	Number of cows/day	Duration (hrs/day)
January (31 days)			
February (28 days)			
March (31 days)			
April (30 days)			
May (31 days)			
June (30 days)			
July (31 days)			
August (31 days)			
September (30 days)			
October (31 days)			
November (30 days)			
December (31 days)			

Fate of pad effluent

Is *all* the pad effluent collected into the main effluent system (please tick)? ○ YES ○ NO

If no, please describe how pad effluent is managed:

9.3 Leachate from stored feed (silage, etc.).

Volume of leachate produced each year: ______ m³/yr

Is the leachate collected into the main effluent system (please tick)? ○ YES ○ NO

If no, please describe how leachate from stored feed is managed:

9.4 Effluent application area.

Effective area: ______ ha

Natural soil drainage (tick one): ○ Well drained ○ Impeded drainage ○ Poorly drained

Does the area have artificial drainage (tick one)? ○ YES ○ NO

Topography (tick one): ○ Flat ($<4^0$) ○ Undulating (4^0 - 7^0) ○ Rolling + ($>8^0$)

Dominant soil type (circle one):

pumice	*clay loam*
peat	*loamy sand*
clay	*silt loam*
sand	*fine sandy loam*

9.5 **Effluent storage areas. Please enter the size and capacity of each storage facility.**

	Surface area (m^2)	Storage capacity (m^3)	Desludged once every...	Pumped to the irrigator? (tick)
Sumps			year(s)	
Stone traps			year(s)	
Pond #1			year(s)	
Pond #2			year(s)	
Pond #3			year(s)	
Other storage			year(s)	
Totals				

Methods for calculating the area and volume of effluent storage are included in the Reference Guide.

9.6 **Stormwater catchment areas and diversion** (includes all areas that capture and direct stormwater into effluent storage).

	Surface area (m^2)	Tick if stormwater diversion installed	Circle the months when stormwater is diverted away from main effluent storage facilities
Milking shed yards			Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Other yards or holding areas			Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Pads (feedpads, etc.)			Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Roof storm-water			Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Other surface runoff			Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Total			

9.7 **Effluent application details.**

Please enter application depth and the daily volume of effluent applied.

Application depth is the depth of irrigated effluent measured in millimetres. It can be estimated from irrigator speed settings, or measured with collection containers (see the Reference Guide for more information). Most will use a low application depth for wetter periods (e.g. 4 - 8 mm) and a higher depth for drier periods (e.g. 20 mm).

Daily volume of applied effluent can be estimated from pumping rate and duration, or from irrigator coverage and duration (see the Reference Guide for more information).

Irrigator type

Please describe the type of irrigator used to apply effluent (e.g. gun, travelling irrigator, pod system, Larall, etc.).

____

____

____

____

____

	Application depths (mm)	Average volume applied per day (m^3/day)
Jan		
Feb		
Mar		
Apr		
May		
Jun		
Jul		
Aug		
Sep		
Oct		
Nov		
Dec		

10. Supplementary information for MINOR water takes

Please complete this section if you are applying for minor surface water takes (up to 30m^3/day, see 8.$_{30}$) or minor groundwater takes (up to 50m^3/day, see 8.$_{36}$).

10.$_1$ Ensure that extraction sites for each minor water take is marked on the property map (see Section 3).

10.$_2$ Please complete the table below (refer to the Reference Guide for methods to calculate Peak Daily Demand):

Your map reference	Type of take (surface or groundwater)	Intended use of the extracted water (e.g. stockwater, shed water, domestic supply, irrigation, other farm use - please specify)	Peak daily demand (m^3/day)

10.$_3$ Please attach any supplementary information to support your peak daily demand estimate.

11. Supplementary information for MAJOR surface water takes

This section only needs to be completed if the application involves surface water takes >30m^3 per day (8.42).

11.1 What will the water be used for? (please tick and fill in required details)

○ Irrigation.
Water source: ________________ stream/river/lake
Maximum volume required per day: __________ m^3/day*
Number of hours per day that the extraction will be active: __________ hours/day
How many days will it take to irrigate the whole area? __________ days
Type of irrigator: ________________
Application rate: __________ m^3/min *or* m^3/hour* *(delete not applicable)*
Do you have a flow meter installed? ○ YES ○ NO
Do you have a telemetry system installed? ○ YES ○ NO

○ Washdown water.
Water source: ________________ stream/river/lake
Maximum volume required per day: __________ m^3/day*
Do you have a flow meter installed? ○ YES ○ NO
Do you have a telemetry system installed? ○ YES ○ NO

○ Stock water.
Water source: ________________ stream/river/lake
Maximum volume required per day: __________ m^3/day*
Do you have a flow meter installed? ○ YES ○ NO
Do you have a telemetry system installed? ○ YES ○ NO

○ Domestic supply.
Water source: ________________ stream/river/lake
Maximum volume required per day: __________ m^3/day*
Number of properties to be supplied: __________ properties
Do you have a flow meter installed? ○ YES ○ NO
Do you have a telemetry system installed? ○ YES ○ NO

○ Other.
Please describe: ________________
Water source: ________________ stream/river/lake
Maximum volume required per day: __________ m^3/day*
Do you have a flow meter installed? ○ YES ○ NO
Do you have a telemetry system installed? ○ YES ○ NO

11.2 Please list all persons with permission to extract water within 1 km upstream and downstream of your site. Include yourself if you have an existing take.

____

____

____

____

____

____

* To convert litres to cubic metres (m^3) muliply by 0.001 (1 litre = 0.001 cubic meters).

12. Final details

12.1 Please tick off the items that you will be attaching to this application form:

- Land Use Capability map *(3.1)*
- Property map *(3.2)*
- Extra sheet of special N-mitigations *(6.3)*
- Overseer Nutrient Budget reports *(7.1)*
- Written permission from neighbouring bore owners, if needed *(8.37)*

Other attachments - please specify:

- ______________________________
- ______________________________
- ______________________________
- ______________________________

12.2 Please indicate the fee enclosed for processing this resource consent application $ ______________

A full list of resource consent processing fees are included in the Reference Guide (see 12.2). Please make cheques payable to *Horizons Regional Council*. If you are unsure what your fee should be please contact the Consents Team on freephone 0508 800 800.

12.3 Requested term of the resource consent ______________ years

12.4 Signature of applicant, or person acting as the agent of the applicant:

______________________________ ______________

Signature Date

Please enclose all the required forms, supporting information, and the consent application fee, and deliver to the following address:

FARM Strategy consent applications
Resource Consents
Horizons Regional Council
11-15 Victoria Avenue
Private Bag 11 325
Palmerston North 4442

horizons regional council

11-15 Victoria Avenue
Private Bag 11 325
Manawatu Mail Centre
Palmerston North 4442

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help@horizons.govt.nz
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