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 MR PETER HAROLD TAYLOR
ON BEHALF OF HORIZONS REGIONAL COUNCIL

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1. INTRODUCTION

My qualifications/experience

1. My full name is Peter Harold Taylor and I am employed by the Horizons Regional Council as Coordinator Plan Implementation. I have been in this role since August 2008 concentrating primarily on completing the testing of Farmer Applied Resource Management Strategies.

2. Prior to joining Horizons I was employed by Fish and Game New Zealand for twenty seven years based in Manawatu. My role was Senior Fish and Game Officer providing technical advice to the Fish and Game Council on sportsfish and gamebird management for the lower North Island. Before this I had eight years with the New Zealand Wildlife Service and four years working on farms.

3. Throughout my career I have worked in close association with farmers. My role with Fish and Game, advocating for the protection of sportsfish and gamebird habitats, brought me into regular contact with the farming fraternity which led to a well developed appreciation of farming matters. Negotiating mutually agreeable outcomes was a regular occurrence. It is my environmental experience coupled with my understanding of farming and farmers that stood me in good stead for the task of facilitating the testing and development of the Farmer Applied Resource Management Strategies.

4. 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

5. My original involvement in the Proposed One Plan was as a submitter on behalf of Fish and Game New Zealand. In that submission Fish and Game supports the approach to maintain and improve water quality, and in particular the regulatory control of intensive farming in catchments where water quality is poorest. I do not believe that involvement compromises the evidence I now present on behalf of Horizons. The similarity in the two roles is that I have always looked for practical and harmonious solutions to problems of water quality. The difference is working directly with farmers seeking the means to resolving these problems. My role at Horizons therefore has been to facilitate the testing of the Farmer Applied Resource Management Strategy (FARMS). The testing has been necessary to establish its strengths and weaknesses under the varying and challenging conditions facing farming in the region. Following the testing of 21 farms, I sought

solutions to a number of issues raised and provided guidance to Policy on the merits of the FARMS as a method for controlling the diffuse loss of contaminants to water from “intensive” farms.

Scope of evidence

6. Rule 13-1 of the Proposed One Plan (POP) stipulates that the activity of farming intensively in priority catchments be a controlled activity. Control is to be applied through the use of a Farmer Applied Resource Management Strategy (FARMS).

7. In my evidence I will describe the following:
   - The purpose of the FARMS, what a FARMS is, and how it is processed into consents;
   - The types of farms covered by a FARMS;
   - The selection process for the 21 farms that were tested;
   - The key elements of the FARMS, how the results compared to the Dairy and Clean Streams Accord, what we learnt, and solutions recommended,
   - How and when FARMS will be implemented.

8. In concluding I cover the benefits of this approach to control non-point source contamination of water.

2. EXECUTIVE SUMMARY OF EVIDENCE

Introduction

9. Farmer Applied Resource Management Strategies (FARMS), required under Rule 13-1 of the Proposed One Plan (POP), have been devised to control non-point source contamination of water from intensive farms within priority catchments. The contaminants of interest are Phosphorus (P), faecal bacteria, sediment, and Nitrogen (N). Priority catchments are described in the evidence of **K. McArthur**. “Intensive” farming covers cropping, dairying, irrigated sheep and beef, and market gardening or commercial vegetable production. Definitions are provided in the revised FARMS Workbook 3 (Manderson, 2009b)[1] and the reasons for focusing on intensive farming are described in the evidence of **J. Roygard**.

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[1] Manderson, A. 2009b. FARM Strategy consent application (FARMS Workbook 3). Consent application form and reference guidebook prepared for Horizons Regional Council, Palmerston North.

10. The FARM Strategy is output based: That is, it focuses on measures that are the product of the farm, not inputs to the farm such as stocking rate, amount of fertiliser used, or amount of feed imported. The sources of contamination are assessed on each farm and where these breach the POP, this is highlighted on the compliance checklist and remedial or mitigation actions can be specified. Options to mitigate N-loss are recommended to the farmer. The cost of these mitigation options can be weighed up against their effectiveness and the farmer chooses which of these they will implement as conditions on their consent.

11. The completed FARMS is signed by the farmer and becomes their consent application. This application can cover more than one activity and each will be identified. With respect to conditions controlling contamination of water, these will be the agreed mitigation options the farmer has accepted in their FARMS. Horizons processing of the consent will be "fast tracked" if it has been completed properly by a qualified person. A qualified person will need to have passed an OVERSEER® certification course and be able to demonstrate competency in farm management systems. Under these circumstances processing the consent should take no more than two hours whereas, by comparison, a farm dairy effluent discharge consent currently takes between six and eight hours to process. Applications that have not been completed by a qualified person will be sent to a qualified person to be peer reviewed.

The key elements of a FARMS

12. The FARMS is a whole farm assessment of non-point source contaminants likely to enter water. To limit P, faecal bacteria, sediment and N, FARMS prescribes such measures as:

- Excluding stock from waterways,
- Preventing stock crossings of waterways;
- Preventing effluent run-off to waterways from raceways;
- Managing contaminants leaching from feed storage areas, feed out areas, and effluent storage ponds;
- Setting permissible N-loss targets for each farm.

13. Contaminant assessment is visual, in conjunction with the farmer, except for N-loss. N-loss for the whole farm is estimated using OVERSEER (refer to the evidence of **S. Ledgard**).

14. The permissible N-loss target, expressed numerically as kg N/ha/yr, for each farm is calculated using the following four steps:

i. Measuring the area of each Land Use Capability (LUC) class at either a regional (1:50,000) or farm scale within farm boundaries, including support blocks if within the same priority catchment;

ii. Multiplying each area of LUC from step one by the permissible N-loss amount for each of the LUC in Table 13.2 (POP); and;

iii. Adding the permissible N-loss amounts for each LUC (if more than one class), and;

iv. Dividing by the total farm area.

(LUC and its use within the FARMS is described in the evidence of **A. Mckay**).

15. The common mitigation options for reducing N-loss are:

- Reducing the amount of nitrogen applied to the land as fertiliser, particularly during winter;
- Grazing all or part of the milking herd off the farm during winter;
- Using nitrification inhibitors which slow down the conversion of ammonium in the soil to nitrate therefore reducing N-loss;
- Increasing the area of land farm dairy effluent is irrigated to;
- Excluding stock from waterways.

16. In addition to assessing the results against the POP requirements, the test farms were also assessed against the Dairy and Clean Streams Accord (DCSA). This Accord sets performance targets to reduce "…the impacts of dairying on the quality of New Zealand stream, rivers, ground water, and wetlands." DSCA obligations account for most of the POP fencing and farm dairy effluent management requirements, however more bridges and culverts will be needed under the POP.

17. The respective contributions of contaminants were likely to be highly variable depending on a farms location and operational intensity. The FARMS is an innovative and untried approach, and Horizons Regional Council (Horizons) needed to understand, through testing the methodology, the implications of such an approach on intensive farming in selected priority catchments.

Testing the FARMS and selecting the farms to be tested

18. Testing the FARMS had three primary objectives:

- Establishing the level of compliance with the POP, in particular the permissible N-loss targets.
- Where permissible N-loss targets were exceeded, how feasible the known mitigation options were likely to be, and under what circumstances meeting the targets would be most challenging,
- Refining the process of preparation and implementation of FARMS so they could be applied consistently and fairly.

19. Selection and testing had two phases: Initially five farms were selected largely based on dairy farms in priority catchments with known farmers who were willing to participate. After these five FARMS were completed, another fifteen farms were selected by Horizons and one by DairyNZ. The basis for selection of thirteen of these was to assess the impact on dairy farms with high LUC, high rainfall, and high stocking rates. One cropping farm and one irrigated sheep and beef farm were also chosen.

20. Manderson and Mackay (2008)[2], who completed the first five FARMS test farms, suggested three levels of FARMS reporting: "Minimum", "Medium", and "Comprehensive". Their assessments were all "Comprehensive" and Horizons needed to test the other two levels. The choice of which level FARMS would be carried out would rest with the farmer and would depend on the complexity of each farm and what information the farmer thought useful either to mitigate N-loss or improve the farming operation. A "Minimum" level FARMS only requires regional scale versus farm scale LUC mapping and is a key difference compared to the other two levels. Regional scale mapping can be obtained at little or no cost from Horizons, whereas farm scale requires an on-site visit by a suitably qualified person.

Test farms results

21. Twenty-one farms have been tested. Additionally, of these farms, three had operations or scenarios that were separately assessed for N-loss.

22. Phosphorus, faecal bacteria, and sediment entering water via surface run-off can be prevented by fencing stream margins creating a buffer to trap these contaminants. The

[2] Manderson A, and A Mckay. 2008. FARMS test farms project. Testing the One Plan approach to contaminant management and linking the FARM Strategy to the SLUI Whole Farm Plan design. Ag Research Ltd.

range of fencing required on farms tested to be compliant with both the DCSA and the POP was 0km - 32km. The farm that required 32km had recently converted from a standard sheep and beef farm to dairy. Removing this farm from the calculation, the range was 0km - 3.8km and the average fencing per farm 0.93 km.

23. Direct stock defecations and urinations to water can be prevented by spanning waterways using bridges or culverts at stock crossings. To comply with the DCSA, five culverts were required. To comply with the POP, four bridges and 36 culverts were required, and one raceway needed to be re-aligned to prevent effluent run-off entering a waterway.

24. Poorly managed Farm Dairy Effluent (FDE) can exacerbate the run-off or leaching of contaminants to water. Three farms need to expand their irrigated FDE area; nine farms need to seal their effluent storage ponds; three have insufficient capacity in their ponds for the number of cows being milked; one has to improve capture of feed storage leachate; and one needs to discharge FDE further away from a residence and public road.

25. Excluding the Day farm as it does not qualify as an "intensive" farm under the POP definition, 9 farms (45%) are currently compliant with the year 1 permissible N-loss targets, and 6 farms (30%), under current operating regimes, would be N-loss compliant after twenty years. Of those 11 farms not compliant at year 1, seven farms (64%), using high to medium cost effective N-loss mitigation options, can achieve their year 1 permissible N-loss targets. Four farms (36% of the 11), cannot meet their year 1 targets without major change to their current farm operations. These four represent 20% of all "intensive" farms tested.

26. The range of N-loss reductions required for the 11 farms to meet their year 1 targets, based on current operations, is 1kg N/ha/yr to 18kg N/ha/yr. The average reduction required for these farms, to meet year 1 targets, is 7.91kg N/ha/yr, which declines markedly for subsequent years.

The implications of FARMS on intensive farms

27. The FARMS non-point source contaminant standards are, on the whole, achievable. Fencing of waterways is easily done, and for all but one of the farms tested, very little is required. Few bridges are necessary but the costs are very high and so a cost effective and practical solution is needed. Culverts, provided they are of the right dimensions and

properly installed are a feasible and cost effective measure to span stock crossing points. The re-alignment of raceways can be expensive and, in light of the low frequency of the problem, a case by case assessment of the options is the practical way forward.

28. Most test farms need to improve their FDE management. Of all the areas where contaminants entering water are a problem, this is where most of the improvements to "best practice" are being made. The practice of "deferred irrigation" of FDE, whereby effluent is applied at a rate equal to the soil moisture deficit, is gaining acceptance and for it to work, adequate storage capacity of effluent is essential. Also, the sealing of these effluent storage ponds, albeit at high cost, is necessary (refer to the evidence of **J. Roygard**) and generally recognised.

29. The estimation of N-loss from the whole farm using OVERSEER and relating this to the area of each LUC class to set a permissible N-loss target for each farm is an innovative step forward. The large majority of farms tested will be able, using current technologies, to meet the year 1 targets set in Table 13-2 of the POP. For those farms that cannot achieve the full reduction required without significantly changing their farm operation, an additional policy/rule response is necessary. Sand country farms under permanent irrigation may be able to re-classify to a lower (more favourable) class, their LUC classes that have a soil moisture deficit limitation, which will increase their permissible N-loss target. For example an adjustment to the Johnston farm class VIs4 land to class IV, raises the year 1 permissible N-loss target from 16.4 to 17.6kg N/ha/yr. Similarly, farmers will have the choice of regional or farm scale LUC mapping, which, in some cases, has made a significant difference to their permissible N-loss targets.

30. Manderson and Mackay (2008) (p28) stated they expected most intensive farms to have little difficulty complying with the N-loss limits. However, they state exceptions "…may include ultra-intensive operations, new intensive land uses venturing into marginal landscapes, and farms with particular high-risk landuse/environment combinations (eg. high rainfall + coarse shallow soils + low capability land + few tree/redundant areas + high stocking rates)".

31. Using the criteria of rainfall 1200mm or greater, and the percentage of LUC class IV or greater being more than 60%, **M. Clark** has estimated the number of properties that are encompassed by these. The criteria were chosen being common to the test farms unable to meet the year 1 permissible N-loss targets after implementing the most cost effective mitigation options recommended. The number of properties affected, greater than 50ha, 60ha, and 70ha, are 67, 56, and 48 respectively. This number is not exact

because of the other factors driving N-loss that we cannot generically quantify. Four of the most challenged test farms that fell within these criteria, could achieve between 56% and 82% of their year 1 permissible N-loss targets if they implemented the recommended mitigation options.

32. Some farms, to reach full compliance, if they were to remain farming conventionally, would need a substantial change to their current operation, like for example, shifting all the cows off the farm in the winter, building a herd home, purchasing a support block, reducing cow numbers, or some combination of these. An alternative to this could be changing from a conventional system to a bio-dynamic or organic system. Such a change would take time and imposes greater disruption than making improvements to a conventional system.

Lessons learnt

33. A considerable number of improvements have been suggested by the researchers who have completed the test farms to the FARMS methodology. These are covered in some detail in the body of my evidence and suffice to say, the suggestions are all feasible and strengthen the consistency and fairness of the FARMS. They do not suggest the methodology is fundamentally flawed and therefore unworkable. A revised Workbook (consent application and reference guide) has been produced. Some lessons however stood out for example estimating N-loss across the whole farm area was necessary rather than on “effective” farm area. Whole farm area could be consistently applied; it enabled benefit to farmers by including non-productive areas thereby giving these areas value; and made sense in that the permissible N-loss targets were based on total catchment area which is the sum of all whole farm areas. Also, being able to give farmers a choice of regional or farm scale LUC mapping which made a tangible difference to some farms and a major difference to one farm in particular. There appears no pattern as to which farms would benefit from which scale and so a visual assessment from a qualified person would be needed on a case by case basis. A further point, which is both an implication and a lesson, is the accuracy of farm records relating, particularly, to fertiliser use, but also stock reconciliation data. The need for accurate farm records to be kept was identified by the consultants. Some farms were exemplary in this and others very poor. It is a critical facet to the success of the methodology and therefore the improvements to water quality it is intended to make.

Conclusion

34. The FARMS is an output based environmental assessment of the whole farm focusing on the loss of contaminants from the farming operation. It puts much needed context around the assessment of farm activities that together have a cumulative adverse environmental effect. It has the flexibility to allow individual farm solutions where environmental improvements are required. It packages information for the farmer some of which may have been unknown or not previously considered either relevant or useful – for example LUC mapping, nutrient budgets, management of FDE as a nutrient, and the amounts, timing, and placement of fertiliser use. It provides an opportunity to engage and work constructively with farmers to achieve targets.

35. In my opinion the Farmer Applied Resource Management Strategy is an effective and constructive way of engaging with intensive farms and will be a successful tool in managing, and thereby reducing, the loss of contaminants from "intensive" farms within priority catchments.

3. EVIDENCE

The purpose, principle, and processing of a Farmer Applied Resource Management Strategy

36. The FARMS is a whole farm contaminant management plan designed to limit non-point source contamination of water from intensive land-uses in priority catchments (refer to the evidence of both **J. Roygard and K. McArthur**). The FARMS is an output based method that uses a whole farm assessment to identify sources of contaminants entering water, and proposes, with respect to N-loss at least, mitigation options to prevent or limit this infiltration. The contaminants to be controlled are Phosphorus (P), faecal bacteria, sediment, and Nitrogen (N) and the extent of the controls are expressed in terms of compulsory best management practices (P, faecal bacteria, and sediment) and numerical targets (N).

Background to the development of the FARMS approach

37. It is proposed that farming intensively (refer to the evidence of **Jon Roygard**), in priority catchments, be a controlled activity. A controlled activity consent application is not notified and has to be granted if it meets the conditions over which control is exercised. If an applicant fails to meet any condition it is then notified and assessed as a discretionary consent application.

38. The FARMS Workbook (2007) details how the permissible N-loss targets are calculated from the LUC classes as prescribed in Table 13-2 of the POP. Why the LUC classes are used for this purpose is explained in the evidence of **A. Mckay**. The permissible N-loss target for each farm is then compared to the farm's current N-loss as modelled by OVERSEER. An explanation of OVERSEER is found in the evidence of **S. Ledgard.**

39. The completion of the revised FARMS Workbook 3 (Manderson, 2009b) is the farmer's consent application. Insofar as he or she is concerned they are making one application whether or not more than one activity is involved (a fuller explanation of the consent process can be found in paragraphs 123 and 124).

The key elements of a FARMS assessment

40. Limiting three of these contaminants (P, faecal bacteria, and sediment) requires:
    i. Preventing stock effluent entering water from surface run-off from paddocks and raceways or direct input at stock crossing points.
    ii. Managing surface run-off of leachate and effluent from feed storage areas, feed out areas, and effluent storage ponds.

41. The methods to be used to limit contaminant infiltration are the fencing of waterway riparian margins, spanning waterways at stock crossing points, diverting leachate and effluent to effluent storage ponds, and requiring the sealing of effluent ponds.

42. These entry points are visually assessed and quantified in consultation with the farmer.

43. The assessment of nitrogen (N) loss is estimated using OVERSEER which is then compared to the permissible N-loss targets.

44. The permissible N-loss target, expressed numerically as kg N/ha/yr, for each farm is calculated using the following four steps:
    i. Measuring the area of each Land Use Capability (LUC) class at either a regional (1:50,000) or farm scale within farm boundaries, including support blocks if within the same priority catchment;
    ii. Multiplying each area of LUC class from step one by the permissible N-loss amount for each of the LUC classes in Table 13.2 (POP); and;
    iii. Adding the permissible N-loss amounts for each LUC (if more than one class), and;
    iv. Dividing by the total farm area.

45. The methods for limiting the amount of N lost to water are varied. Which method, or methods, will be the farmer's choice and will likely be based on the respective cost effectiveness of each option as modelled in OVERSEER. In the main, reducing the amount of nitrogen applied to the land as fertiliser, particularly during winter; grazing part of the milking herd off the farm during winter; using nitrification inhibitors; and increasing the area of land farm dairy effluent is irrigated to, have been the preferred options.

46. In addition to the POP requirements for complying with contaminant standards, is the Dairy and Clean Streams Accord (DCSA) signed in 2003. The parties to this Accord are Fonterra Co-operative Group, Regional Councils, and the Ministries for the Environment and Forestry and Agriculture. Its purpose is: "This Accord provides a statement of intent and framework for actions to promote sustainable dairy farming in New Zealand. It focuses on reducing the impacts of dairying on the quality of New Zealand streams, rivers, lakes, ground water and wetlands."

47. A part of the FARMS assessment was to compare the obligations dairy farmers had under the DCSA and requirements under the POP FARMS Workbook. I will therefore state each of these where relevant and comment on their similarities and differences.

48. **DCSA:** "Dairy cattle are excluded from streams, rivers and lakes and their banks. - Streams are defined as deeper than a Red Band (ankle depth) and wider than a stride, and permanently flowing."

49. **POP:** The FARMS Workbook (2007) asked "Are all stock physically prevented from entering waterways that are 'wider than a stride and deeper than a redband gumboot'?"

50. **Comment:** In this aspect the DCSA and the POP are the same.

51. **DCSA:** "Farm races include bridges or culverts where stock regularly (more than twice a week) cross a watercourse.
PERFORMANCE TARGET:
50% of regular crossing points have bridges or culverts by 2007, 90% by 2012."

52. **POP:** The FARMS Workbook (2007) asked "Are all points where stock cross waterways bridged or culverted to prevent effluent entering water?"

53. **Comment:** The difference between the DCSA and the POP is all crossings under the POP are to be bridged or culverted, not just those being crossed more than twice weekly.

54. **DCSA:** "Farm dairy effluent is appropriately treated and discharged.
PERFORMANCE TARGET:
100% of farm dairy effluent discharges to comply with resource consents and regional plans immediately."

55. **POP:** The FARMS Workbook (2007) lists the following:

- "Will there be any direct discharges of effluent into a surface waterbody?"
- "Are all effluent storage and treatment facilities sealed to prevent seepage of effluent (maximum permeability 1x 10^{-9} metres per second)?"
- Is all effluent collected in a sump or a pond that has the capacity to hold at least two days volume of effluent before the effluent is discharged?"
- "Will there be any ponding of effluent on the soil surface for more than 5 hours following application?"
- "Will any stormwater be discharged into the effluent treatment and storage facilities?"
- There are a further five questions relating to the separation of effluent disposal from public places, residences, and cultural, archaeological and environmental sites of importance.

56. **Comment:** In the above matters, if the farmer is compliant with the POP they are also compliant with the DCSA.

57. **DCSA:** "Nutrients are managed effectively to minimise losses to ground and surface waters.
PERFORMANCE TARGET:
100% of dairy farms to have in place systems to manage nutrient inputs and outputs by 2007."

58. **POP:** Rule 13-1 sets targets for permissible N-loss based on the proportion of LUC over total farm area. Uses OVERSEER modelling to assess each farms current N-loss and the benefit to be gained from mitigation options.

59. **Comment:** The important difference between the DCSA and the POP is that the DCSA uses subjective terms like "managed effectively to minimise" and "systems to manage"

which have no specificity and therefore their contribution to water quality improvement cannot be measured and the opportunity for between farm variance could be considerable.

60. **DCSA:** "Existing regionally significant or important wetlands (as defined by regional councils) are fenced and their natural water regimes are protected.
PERFORMANCE TARGET:
50% of regionally significant wetlands to be fenced by 2005, 90% by 2007."

61. **POP:** Natural wetlands greater than 0.5ha, and artificial wetlands greater than 1.0ha, are protected by Rule 12-8 where activities that may threaten their viability require a non-complying consent application.

62. **Comment:** The difference between the two is the DCSA is proactive, the POP reactive – at least in terms of the POP Rule. The POP does have a method though where the top 100 wetlands will be under active management within the life of the plan.

63. The respective targets are repeated under each of the contaminants of interest as presented in the results below.

The types of farms a FARMS applies to

64. In terms of the POP, "intensive" farming covers cropping, dairying, irrigated sheep and beef, and commercial vegetable production as defined below. The following definitions are from the POP Glossary.
    i. "**Cropping** refers to properties greater than 4 ha mainly engaged in growing cereal, coarse grains, oilseed, peanuts, lupins, dry field peas or dry field beans. This does not include occasional use of land for these crops or growing of fodder crops which are to be used on the property."
    ii. "**Dairy farming** refers to properties greater than 4 ha and mainly engaged in the farming of dairy cattle."
    iii. "**Intensive sheep and beef farming** refers to properties greater than 4 ha mainly engaged in the farming of sheep and cattle, where the land grazed is irrigated."
    iv. "**Market gardening** refers to properties greater than 4 ha mainly engaged in growing vegetables for human consumption (except dry field peas or beans), tree nuts, citrus fruit or other fruit."

65. Given the complexity of farm types and different operations within farms within the priority catchments, and FARMS as an innovative and untried approach, Horizons Regional Council (Horizons) needed to understand the implications of such an approach on intensive farming.

Testing the FARMS

66. The testing of farms began in 2007 with the compilation of the first FARMS Workbook (2007). AgResearch, Palmerston North, was contracted to assess the FARMS Workbook requirements on five farms, geographically spread within the priority catchments, except for one farm outside a priority catchment that was contemplating partially converting to dairy. These reports were completed in 2008 (Manderson and Mckay (2008). In October 2008 Horizons held a meeting in Palmerston North of interested parties to impart the findings of these FARMS test farm reports and seek feedback on the issues raised. One of the key findings of Manderson and Mckay (2008) was that they expected most farms in the region to have little difficulty complying with the permissible N-loss targets. They did suggest however some possible exceptions which, "…may include ultra-intensive operations, new intensive land uses venturing into marginal landscapes, and farms with particular high-risk landuse/environment combinations (eg. high rainfall + coarse shallow soils + low capability land + few tree/redundant areas + high stocking rates)".

67. Farms in these situations were more likely to leach higher amounts of N because:

- The more intensive, the higher the input of N into the farming system through supplementary feed, higher nitrogen fertiliser use, therefore higher stocking rates, and therefore the potential for higher N-loss.
- The use of LUC to calculate permissible N-loss Table 13-2 of the POP; Table 5 of my evidence), is weighted to benefit the low LUC class (most versatile) soils and this meant comparatively lower permissible N-loss limits for farms with a high percentage of the high LUC class soils.
- OVERSEER, in estimating N-loss, is weighted much more heavily against high rainfall. That is, the higher the rainfall the higher the estimated N-loss.

68. Following this meeting it was decided to contract the testing of another 15 farms with the intent of broadening the geographical range, including a cropping and irrigated sheep and beef farm, and especially test farms Manderson and Mckay (2008) said may struggle meeting the permissible N-loss targets. These farms were selected in December 2008 and testing began early in 2009 by three consultants, AgResearch,

Hamilton; LandVision, Wanganui; and Sheppard Agriculture, Dannevirke. These reports were completed in August 2009. DairyNZ also expressed an interest in completing a FARMS. They subsequently selected a farm and finished their report in July 2009 which they forwarded to Horizons for inclusion into the test farms results.

69. Testing was to establish, on each farm:

i. The level of information required commensurate with the complexity of the farming operation and difficulty the farm may have complying with the POP.

ii. The extent of stock access to waterways.

iii. The number of bridges and culverts required to span stock crossings.

iv. The extent of improvements to raceways needed to prevent contaminants washing directly into waterways.

v. Establishing current levels of N-loss from farms and where there was difference between current levels and the proposed targets, how achievable those targets were.

vi. The circumstances that would provide the biggest challenge to meeting the permissible N-loss targets.

vii. A thorough FARMS preparation process for the consistent recording of information, consistent treatment of the range of differing farm scenarios, and concise definition of terms.

How test FARMS were selected

70. The Manderson and Mckay (2008) farms comprised two dairy farms, two farms with a dairy/drystock/cropping mix, and one standard sheep and beef farm contemplating partial conversion to dairying. Farm selection was based on a variety of farm type with farmers willing to participate and spread across three of the priority catchments.

71. The 15 farms selected for testing in 2009 comprised thirteen to assess the impact on dairy farms with high LUC, high rainfall, and high stocking rates as discussed above. One cropping farm and one beef farm under irrigation were chosen to assess the implications for these farm types.

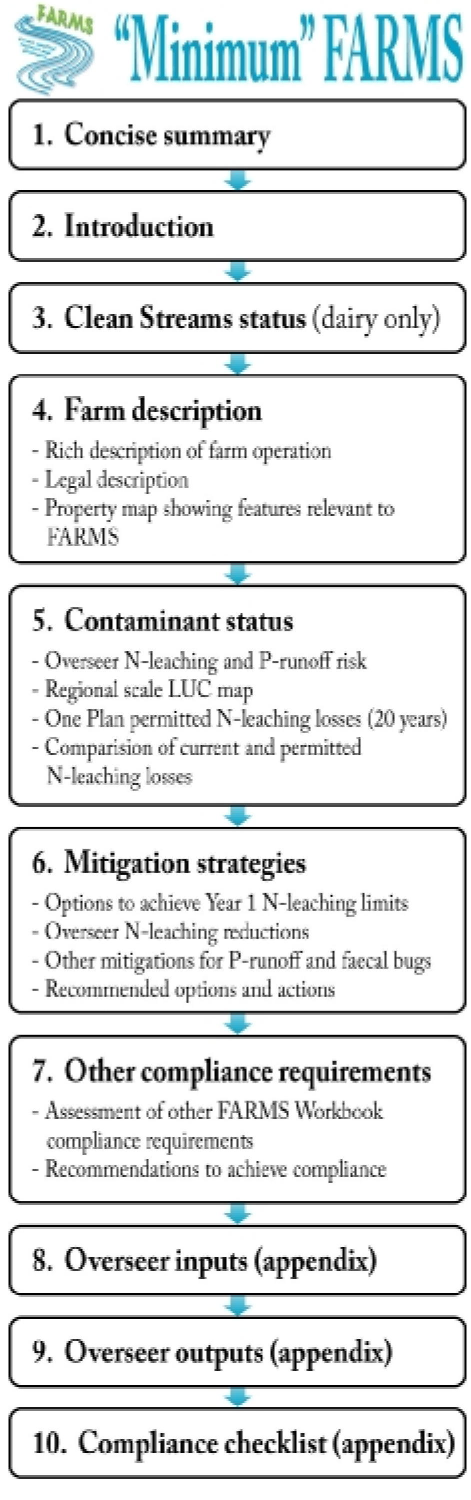
72. A FARMS was also completed independently by DairyNZ. The outcomes from this farm are included in the results presented.

73. Manderson and Mackay (2008) had completed “Comprehensive” versions of FARMS: Horizons also wanted to test the suitability of their proposed “Minimum” and “Medium”

level FARMS and expose other suitably qualified consultants to the FARMS method to broaden the critical comment on its application.

Reporting Levels of FARMS

74. The flow chart below is from Manderson and Mackay (2008) (Part 2, p32-36) where they described three levels of FARMS reporting that would meet the requirements of Rule 13-1 of the POP: “Minimum”, “Medium”, and “Comprehensive”. Alongside this chart are the additional distinguishing features between the different levels.



Medium	**Comprehensive**
Farm scale LUC map. LUC can be "adjusted" for irrigated land.	Farm scale LUC map. More sophisticated modelling to test contaminant risk and mitigation options.
Basic cost estimates for capital works and recommendation of straight - forward mitigation options.	Production and economic evaluation to design new or modified farming systems.
Works map and 5 year programme.	Evaluation and integration of new mitigation technologies.

Figure 1. Flowchart describing three levels of FARMS reporting that could apply: "Minimum", "Medium", and "Comprehensive" (from Manderson and Mackay (2009)).

The selected test farms

75. In addition to the report of Manderson and Mackay (2008), B. Longhurst, AgResearch, completed five test farms. LandVision, Wanganui completed five test farms; R. Rogers, Sheppard Agriculture, Dannevirke completed five test farms plus two further research reports on two of these farms; and S. Ridsdale and M. Bramley, DairyNZ, completed one test farm. These reports are fully referenced in **Appendix 1**.

76. An overview of the location and type of the farms tested, their distinguishing criteria for selection, and the reports authors, are presented in Table 1.

Table 1: Overview of the FARMS test farms.

Farm	Location	Farm type	Priority Catchment	Selection criteria	FARMS Report level	Report author
Barrow	Maharahara, Dannevirke	Dairy	Upper Manawatu	Priority catchment, moderate rainfall	Comprehensive	Manderson and Mackay Ag Research
Day	Pahiatua	Extensive sheep and beef		Sheep and beef comparison.	Comprehensive	Manderson and Mackay Ag Research
Day	Pahiatua	Extensive sheep and beef		Potential dairy conversion	Comprehensive	Manderson and Mackay Ag Research
Glenbrook	Hukanui, Eketahuna	Dairy	Mangatainoka	Priority catchment. High rainfall.	Comprehensive	Manderson and Mackay Ag Research
Flockhouse	Flockhouse, Bulls	Dairy	Lower Rangitikei	Priority catchment	Comprehensive	Manderson and Mckay Ag Research
Tutu Totara	Onepuhi, Marton	Mixed Dairy, sheep and beef	Lower Rangitikei	Priority catchment , complex farm operation	Comprehensive	Manderson and Mackay Ag Research
Martyn Farm	Sanson	Dairy	Lower Rangitikei	Priority catchment, Non-irrigated	Medium	LandVision
Pencoed Farm	Marton	Cropping	Lower Rangitikei	Priority catchment, cropping	Medium	Longhurst Ag Research
Ivo Farm	Kimbolton	Dairy		High altitude, non-irrigated.	Medium	LandVision
Byreburn	Feilding	Dairy		Very high stocking rate	Medium	Longhurst Ag Research
Johnston	Foxton	Dairy		Sand country, irrigated	Medium	Longhurst Ag Research
Moutoa M	Foxton	Dairy		Average farm, non-irrigated	Medium	LandVision
Whirokino Farm	Waitarere	Dairy	Other South-West catchments	Sand country, irrigated	Medium	LandVision
Kane	Lake Horowhenua	Dairy	Lake Horowhenua	Priority catchment.	Medium	LandVision
Jala Enterprises	Nireaha, Eketahuna	Dairy	Mangatainoka	Priority catchment,	Minimum	Rogers Sheppard

Farm	Location	Farm type	Priority Catchment	Selection criteria	FARMS Report level	Report author
				Very high rainfall, high LUC		Agriculture
Stoney Creek Partnership	Woodville	Dairy	Manawatu above Gorge	Priority catchment, high LUC	Medium	Rogers Sheppard Agriculture
Windwood	Top Grass Rd, Dannevirke	Dairy	Upper Manawatu	Priority catchment, high rainfall, high LUC	Medium	Rogers Sheppard Agriculture
Waka Dairies	Kumeti, Dannevirke	Dairy	Upper Manawatu	Priority catchment	Minimum	Rogers Sheppard Agriculture
Oringi Farm	Oringi, Dannevirke	Beef	Upper Manawatu	Priority catchment, irrigated beef	Medium	Longhurst Ag Research
Muskit Enterprises	Matamau, Dannevirke	Dairy	Upper Manawatu	Priority catchment, high LUC	Minimum	Rogers Sheppard Agriculture
Janssen	Norsewood	Dairy	Upper Manawatu	Priority catchment high rainfall, high LUC	Medium	Longhurst Ag Research
Koot	Oroua Downs	Dairy	Coastal Lakes	Priority catchment, sand country, non-irrigated	Minimum	Ridsdale & Bramley DairyNZ

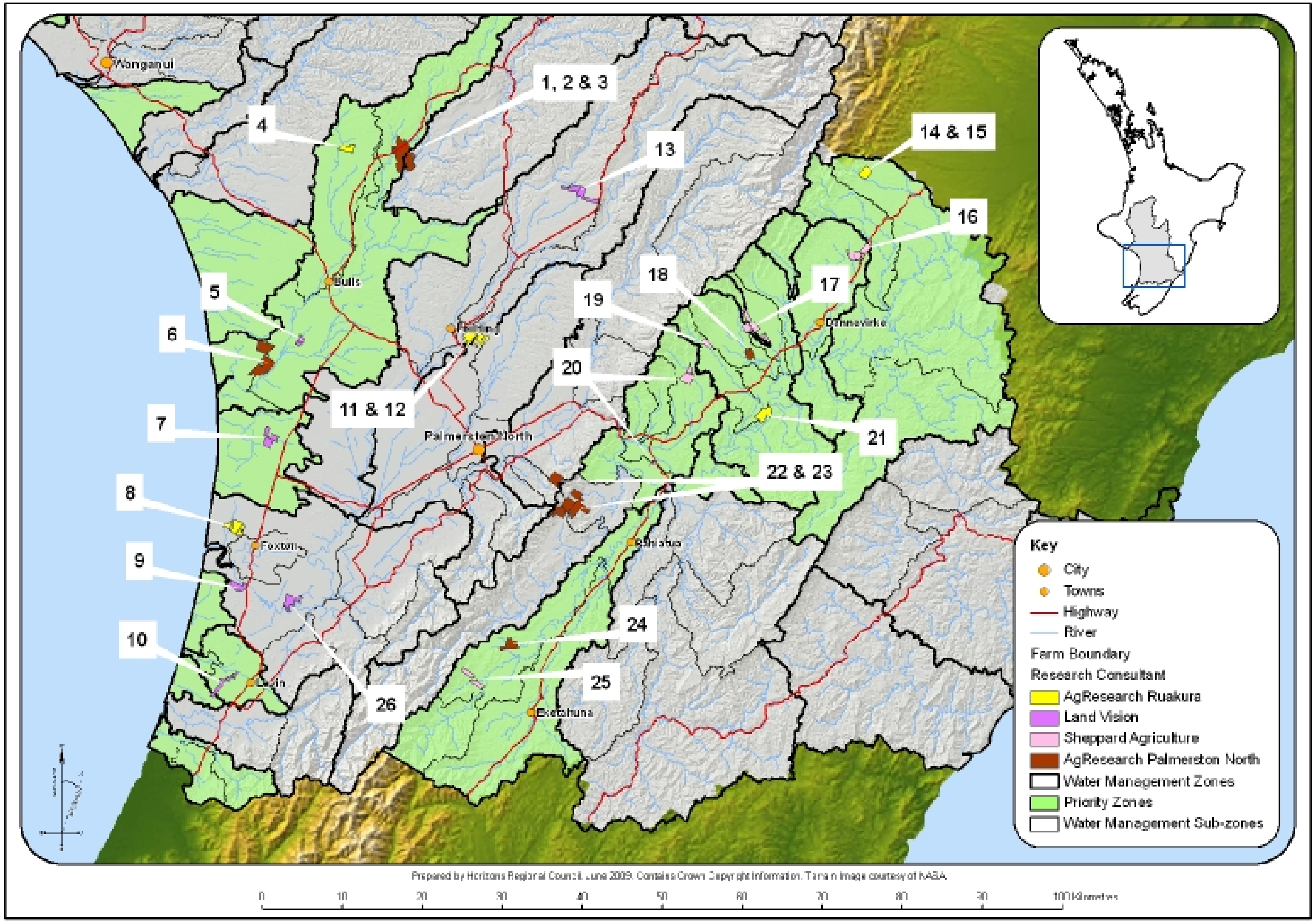

Wanganui
1, 2 & 3
4
13
14 & 15
16
Bulls
5
6
Feilding
18
17
19
Dannevirke
20
11 & 12
Palmerston North
7
21
22 & 23
8
Foxton
Pahiatua
9
24
10
25
26
Eketahuna
Key
City
Towns
Highway
River
Farm Boundary
Research Consultant
AgResearch Ruakura
Land Vision
Sheppard Agriculture
AgResearch Palmerston North
Water Management Zones
Priority Zones
Water Management Sub-zones

Figure 1.

Figure 1. Legend

Legend for FARMS test farms location map

Farm Name	Map legend No.
Tutu Totara	**1**
Tutu Totara	**2**
Tutu Totara	**3**
Pencoed Trust Farm	**4**
Martyn	**5**
Flockhouse	**6**
Koot	**7**
Johnston	**8**
Whirokino Farm Ltd	**9**
Hokio Farm	**10**
Byreburn	**11**
Byreburn	**12**
Ivo Farms	**13**
Janssen	**14**
Janssen	**15**
Muskit Enterprises	**16**
Waka Dairies	**17**
Barrow	**18**
Windwood	**19**
Stoney Creek Partnership	**20**
Oringi Farm	**21**
Day	**22**
Day	**23**
Glenbrook	**24**
Jala Enterprises	**25**
Moutoa M Farm	**26**

The FARMS test farms results

77. The results of the FARMS test farms and are presented according to the contaminant(s) of interest.

78. The results report on:

i. The extent to which fencing, culverting, bridging and raceways, prevent stock access and surface run-off to water, and how the current situation relates to the DCSA and the POP requirements (Tables 2 and 3).

ii. N-loss to water from site specific sources such as feed storage areas, feed pads, and effluent ponds (Table 4).

iii. Current N-loss from across the whole farm and how this relates to the POP numerical N-loss targets (Table 6).

79. Some farms had more than one farming operation assessed. For example pre conversion and post conversion (Day) and Tutu Totara (Dairy unit, crop unit, and whole farm including the sheep and beef unit). These results are shown for comparative purposes to illustrate the respective contributions to N-loss from the farm and by inference, if the unit was an intensive stand alone, what reductions of N-loss would need to be made to comply with the POP permissible N-loss targets.

P-Loss, faecal bacteria, and sediment

80. The relevant DCSA obligations and the POP requirements are:

DCSA:

- "Dairy cattle are excluded from streams, rivers and lakes and their banks. Streams are defined as deeper than a "Red Band" (ankle depth) and "wider than a stride", and permanently flowing."
- "Farm races include bridges or culverts where stock regularly (more than twice a week) cross a watercourse. PERFORMANCE TARGET: 50% of regular crossing points have bridges or culverts by 2007, 90% by 2012."

POP: (The FARMS Workbook (2007))

- "Are all stock physically prevented from entering waterways that are 'wider than a stride and deeper than a redband gumboot'?"
- "Are all points where stock cross waterways bridged or culverted to prevent effluent entering water?"

81. Two farms, Oringi Farm and Pencoed Farm, are not dairy farms therefore do not have to comply with the DCSA.

82. P-loss is estimated by OVERSEER and in all farms apart from two was rated as 'low'. It was rated as 'high' for the Day farm (sheep and beef) and 'medium' for Tutu Totara. The POP has no standard that relates to this rating.

83. Phosphorus, faecal bacteria, and sediment entering water via surface run-off can be prevented by fencing stream margins creating a buffer to trap these contaminants. Table 2 shows the extent to which the test farms meet both the DCSA and POP requirements.

Table 2. Kilometres of fencing identified to meet DCSA 2012 obligation and POP requirements.

Farm	Km	Farm	Km
Barrow	3.7	Janssen	1.6
Glenbrook	3.1	Oringi	0
Flockhouse	0	Johnston	0
Tutu Totara	0	Byreburn	0
Stoney Creek	1.6	Pencoed	0
Jala	3.8	Hokio	0
Windwood	2.2	Whirikino	0.5
Muskit	32*	Moutoa M	0
Waka	1.2	Martyn	0
Koot	0	Ivo Farm	0
Sub total	47.6	Sub total	2.1
Total	49.7		

* The Muskit Enterprises estimate is high because a standard sheep and beef unit had recently been brought into dairy production.

84. The range of fencing required is large – 0 km to 32 km. Muskit Enterprises is the notable exception because a standard sheep and beef unit had recently been converted to a dairy unit. On removing this farm the range reduces to 0km to 3.8 km, averaging 0.93 km per farm.

85. Direct stock defecations and urinations to water can be prevented by spanning waterways using bridges or culverts at stock crossings. Table 3 shows which farms need to install these to be compliant with either the DCSA or the POP.

Table 3: Number of bridges and culverts to be installed, and raceways and underpasses requiring improvement, to comply with the DCSA and POP.

Farm	Clean Streams Accord	Proposed One Plan			Farm	Clean Streams Accord	Proposed One Plan		
		Bridge	Culvert	Raceway			Bridge	Culvert	Raceway
Barrow	2culvert	1	2		Janssen				
Glenbrook	3culvert		3		Oringi	N/A			
Flockhouse			1		Johnston				
Tutu Totara			2		Byreburn				1
Stoney Creek			1	1	Pencoed	N/A			
Jala		1	15		Hokio				
Windwood		1	7		Whirikino				
Muskit		1	5		Moutoa				
Waka					Martyn				
Koot					Ivo Farm				
Sub total	5	4	36	1					1
Totals	5 culverts	4 bridges (where either a bridge or a culvert was needed (3 cases), a culvert was assumed to be sufficient) 36 culverts 2 existing raceways need improvement							

Farm Dairy Effluent (FDE) management

86. The relevant DCSA obligations and the POP requirements are:

DCSA:

"Farm dairy effluent is appropriately treated and discharged.

PERFORMANCE TARGET: 100% of farm dairy effluent discharges to comply with resource consents and regional plans immediately."

POP:

The FARMS Workbook (2007) lists the following:

- "Will there be any direct discharges of effluent into a surface waterbody?"
- "Are all effluent storage and treatment facilities sealed to prevent seepage of effluent (maximum permeability $1x10^{-9}$ metres per second)?"
- Is all effluent collected in a sump or a pond that has the capacity to hold at least two days volume of effluent before the effluent is discharged?"
- "Will there be any ponding of effluent on the soil surface for more than 5 hours following application?"
- "Will any stormwater be discharged into the effluent treatment and storage facilities?"

- There a further five questions relating to the separation of effluent disposal from public places, residences, and cultural, archaeological and environmental sites of importance.

87. Three farms need to expand their irrigated FDE area; nine farms need to seal their effluent storage ponds; three have insufficient capacity in their ponds for the number of cows being milked; one has to improve capture of feed storage leachate; and one needs to discharge FDE further away from a residence and public road. (Table 4). One of these compliance requirements, the sealing of effluent storage ponds, has recently been introduced as a best practice consent condition. As such, lack of compliance is not a reflection of farmer performance.

Table 4. Farm dairy effluent – areas of non-compliance

Farm	DCSA and Proposed One Plan	Farm	DSCA and Proposed One Plan
Barrow	• Effluent block too small. • Effluent storage pond not sealed.	Janssen	None
Glenbrook		Oringi Farm	
Flockhouse	• Effluent storage insufficient. • Effluent storage pond not sealed.	Johnston	None
Tutu Totara	• Effluent storage insufficient. • Effluent storage pond not sealed. • Run-off from sheep yards direct to stream. • Shed stormwater enters sump.	Byreburn	• Effluent storage pond not sealed. • Shed stormwater enters effluent pond.
Stoney Creek	• Effluent block too small. • Effluent storage pond not sealed. • Shed stormwater enters effluent pond.	Pencoed Farm	None
Jala	• Effluent storage not sealed. • Shed stormwater enters effluent pond.	Hokio	None
Woodwind	• Effluent storage pond not sealed. • Shed stormwater enters effluent pond.	Whirikino	• Effluent storage insufficient. • Effluent storage pond not sealed. • Shed stormwater enters effluent pond.
Muskit	Effluent pond sealing presumed but not tested.	Moutoa	• Effluent storage pond not sealed. • Effluent block too small.
Waka	Shed stormwater enters effluent pond.	Martyn	Effluent discharge too close to residence and a public road.
Koot	Improve capture of leached feed storage effluent	Ivo	Effluent storage insufficient.

Nitrogen loss

88. The relevant DCSA obligations and the POP requirements are:

DCSA:

"Nutrients are managed effectively to minimise losses to ground and surface waters. PERFORMANCE TARGET: 100% of dairy farms to have in place systems to manage nutrient inputs and outputs by 2007."

POP:

Rule 13-1 (replicated in the FARMS Workbook 2007) sets targets for permissible N-loss based on the proportion of LUC over total farm area (Table 13-2 of the POP; Table 5 in my evidence) and uses OVERSEER modelling to assess each farm's current N-loss, and the benefit to be gained from mitigation options.

89. Again, the important difference between the DCSA and the POP is the subjectivity of the DCSA and the targets for controlling N-loss to water in the POP. The advance the DCSA made is raising the awareness that nutrient management was a concern – otherwise this obligation has no value. It fails to link that awareness to specific environmental consequence and therefore limits that would give affect to minimising losses to ground and surface water.

Table 5. Proposed One Plan Table 13-2 Land Use Capability permissible N-loss values

	LUC I	LUC II	LUC III	LUC IV	LUC V	LUC VI	LUC VII	LUC VIII
Year 1 (when rule comes into force) (kg of N/ ha/year)	32	29	22	16	13	10	6	2
Year 5 (kg of N/ ha/year)	27	25	21	16	13	10	6	2
Year 10 (kg of N/ ha/year)	26	22	19	14	13	10	6	2
Year 20 (kg of N/ ha/year)	25	21	18	13	12	10	6	2

90. Some of the FARMS test farms had multi faceted farming operations: For example Tutu Totara comprised standard sheep and beef, crop, and dairy (Table 6). In addition, one farm contemplated dairy conversion (Day) and one farm intends to significantly intensify (Janssen). Each situation was assessed for its N-loss.

Table 6. N-loss status for all farms and farm operation type assessed within some farms.

Farm Name	Farm type	N- loss (kg/ha/yr)	Proposed One Plan permissible N-loss targets adjusted for LUC area			
		Current (whole farm)	Year 1 target	Year 5 target	Year 10 target	Year 20 target
Barrow	Dairy	25	24	21	19	18
Glenbrook	Dairy	26	20	19	17	16
Flockhouse	Dairy/Drystock	18	24	21	20	19
Day (sheep/beef)	Whole farm	10	11	11	10	10
Day (including conversion)	Dairy	30	13	13	12	12
Tutu Totara	Dairy	17	25	22	20	20
Tutu Totara	Crop	24	30	26	23	22
Tutu Totara	Whole farm	16	25	22	20	20
Stoney Creek Partnership	Dairy	31	18	17	15	15
Jala Enterprises	Dairy	31	20	18	16	16
Windwood	Dairy	25	21	19	17	16
Muskit Enterprises	Dairy	34	16	15	14	14
Waka Dairies	Dairy	35	24	22	20	19
Janssen (380 cows)	Dairy	28	19	17	16	15
Janssen (500 cows)	Dairy	40	19	17	16	15
Oringi Farm	Beef	19	25	23	20	19
Johnston	Dairy	25	16	16	15	14
Byreburn (no support block)	Dairy	37	29	25	23	22
Byreburn (with support block)	Dairy	28	29	25	23	22
Pencoed Trust Farm	Crop	30	31	27	25	24
Hokio Farm	Dairy	26	26	23	21	20
Whirokino Farm	Dairy	18	16	15	14	14
Moutoa M Farm	Dairy	32	29	25	22	21
Martyn	Dairy	16	29	25	22	21
Ivo Farms	Dairy	18	27	23.5	22	21
Koot	Dairy	13	20	19	17	16

91. The range of N-loss reductions required, based on current operations, for the farms to meet year 1 targets is 1kg N/ha/yr to 18kg N/ha/yr (Table 7). A summary of the mitigations options recommended as to how these farms could achieve their targets, either wholly or in part, are presented in Table 12.

Table 7. Current farm operation N-loss (kgN/ha/yr) and subsequent reductions (-) needed, or surplus (+) available, assuming previous target achieved.

Farm Name	Farm Operation type	N- loss (kg/ha/yr)				
		Current N-loss (kgN/ha/yr) for the whole farm	Reduction (-) or surplus(+) relative to Year 1 target	Reduction (-) or surplus(+) relative to Year 5 target	Reduction (-) or surplus(+) relative to Year 10 target	Reduction (-) or surplus(+) relative to Year 20 target
Barrow	Dairy	25	-1	-3	-2	-1
Glenbrook	Dairy	26	-6	-1	-2	-1
Flockhouse	Dairy/Drystock	18	+6	+3	+2	+1
Day	Whole farm	15	-4	0	-1	0
Tutu Totara	Dairy	17	+8	+5	+3	+3
Tutu Totara	Crop	24	+6	+2	-1	-1
Tutu Totara	Whole farm	16	+9	+6	+4	+4
Stoney Creek Partnership	Dairy	31	-13	-1	-2	-2
Jala Enterprises	Dairy	31	-11	-2	-2	-0
Windwood	Dairy	25	-4	-2	-2	-1
Muskit Enterprises	Dairy	34	-18	-1	-1	0
Waka Dairies	Dairy	35	-11	-2	-2	-1
Janssen (380 cows)	Dairy	28	-9	-2	-1	-1
Oringi Farm	Beef	19	+6	+4	+1	0
Johnston	Dairy	25	-9	0	-1	-1
Byreburn	Dairy	37	-8	-4	-2	-1
Byreburn	Dairy	28	+1	-3	-2	-1
Pencoed Farm	Crop	30	+1	-3	-2	-1
Hokio Farm	Dairy	26	0	-3	-2	-1
Whirokino Farm Ltd	Dairy	18	-2	-1	-1	-1
Moutoa M Farm	Dairy	32	-3	-4	-3	-1
Martyn	Dairy	16	+13	+9	+6	+5
Ivo Farms	Dairy	18	+9	+5.5	+4	+3
Koot	Dairy	13	+7	+6	+4	+3

92. Not all farms tested need to reduce their N-loss to meet targets at years 1, 5, 10, or 20. Those farms that do, their amounts (kg N/ha/yr) at the respective target years, are shown in Table 8. The average for each milestone target is calculated. Please note that the year 5, 10, and 20 averages are based on the additional reductions required assuming the previous milestone target was achieved.

93. The greatest average reduction is within year one (Table 9). Once year 1 targets are met minimal further reductions are necessary in subsequent years.

Table 8. The average N-loss reduction required at the respective milestone years

Farm	N-loss reductions (kg N/ha/yr) required to meet targets			
	Year 1 target	**Year 5 target**	**Year 10 target**	**Year 20 target**
Barrow	1	3	2	1
Glenbrook	6	1	2	1
Stoney Creek Partnership	13	1	2	2
Jala Enterprises	11	2	2	
Windwood	4	2	2	1
Muskit Enterprises	18	1	1	
Waka Dairies	11	2	2	1
Janssen (380 cows)	9	2	1	1
Johnston	9		1	1
Byreburn		3	2	1
Pencoed Farm		3	2	1
Hokio Farm		3	2	1
Whirokino Farm Ltd	2	1	1	1
Moutoa M Farm	3	4	3	1
Average	**7.91**	**2.15**	**1.79**	**1.08**

94. Of the farms listed in Table 8 where the greatest reductions are shown to be necessary in year 1, the N-loss mitigation options provided in each of the FARMS test farm reports (Table 12) were rated from high to low for their comparative cost effectiveness. The extent to which these options will enable the farmer to achieve their permissible N-loss targets at year 1 is shown in Table 9. Four of the eleven farms (36%) will not have reasonably cost effective mitigation options available to be fully compliant at year 1. These four farms represent 20% of all “intensive” farms tested.

Table 9. Extent to which known mitigation options of high to medium cost effectiveness can reduce N-loss to achieve year one permissible N-loss targets

Farm Name	Farm Operation type	N- loss (kg/ha/yr)				
		Current N-loss (kgN/ha/yr) for the whole farm	Reduction (-) or surplus(+) relative to Year 1 target	Available mitigation options to reduce kgN/ha/yr		
				High cost effectiveness	Medium cost effectiveness	Percentage gained toward year 1 target
Barrow	Dairy	25	-1	11	0.8	>100
Glenbrook	Dairy	26	-6	7.6	2.6	>100
Stoney Creek Partnership	Dairy	31	-13	7	3.5	81
Jala Enterprises	Dairy	31	-11	9		82
Windwood	Dairy	25	-4	2	2	100
Muskit Enterprises	Dairy	34	-18	6	5	61
Waka Dairies	Dairy	35	- 11	5	10	>100
Janssen (380 cows)	Dairy	28	-9	5		56
Johnston	Dairy	25	-9	10	3	>100
Whirokino Farm Ltd	Dairy	18	-2	4.6		>100
Moutoa M Farm	Dairy	32	-3	8		>100

95. Some farms had higher permissible N-loss targets under farm scale LUC mapping than at the regional scale (Table 10). Different levels of FARMS (“Medium” and “Minimum”) apply different scales of LUC mapping and therefore not all farms had both assessments done. Of the comparisons, Windwood Farm stands out where there is a difference of 7kg N/ha/yr between regional and farm scale mapping. On examination, this difference resulted from large areas of LUC class VI land being re-surveyed as mainly class IV land.

Table 10. Comparison of permissible N-loss between regional and farm scale LUC

Farm Name	Farm Operation type	Permissible N-loss at year 1 (kgN/ha/yr)		
		LUC Regional scale	LUC Farm scale	Difference*
Barrow	Dairy	26	24	- 2
Glenbrook	Dairy	23	20	- 3
Flockhouse	Dairy/Drystock	25	24	- 1
Day	Whole farm	10	11	+ 1
Day	Dairy Conversion	12	13	+ 1
Tutu Totara	Whole farm	25	25	0
Stoney Creek Partnership	Dairy	18	18	0
Windwood	Dairy	14	21	+ 7
Janssen (380 cows)	Dairy	19	18	- 1
Oringi Farm	Beef	25	26	+ 1
Johnston	Dairy	16	16	0
Byreburn	Dairy	29	25	- 4
Pencoed Farm	Crop	31	31	0

* A positive (+) difference shows where it is advantageous to the farmer to use farm scale mapping and a negative (-) difference shows where regional mapping would be better.

96. The principal selection strategy was to better understand which farms may be challenged by the N-loss targets. It was hypothesised that farms with high rainfall, high LUC classes, and high stocking rate variables would be most challenged, and, as Table 11 shows, this is the case. Attention is drawn in particular to those farms identified in Tables 9 and 11 as not being able to meet their year 1 permissible N-loss targets without a major shift in their operations. Not surprisingly, it is not one variable in isolation but a combination that makes for the most challenging situation as confronted by Muskit Enterprises.

Table 11. The FARMS test dairy farms showing the comparisons with rainfall, percentages of LUC classes 4-7 and 6-7, and their respective amounts of N-loss to be reduced to meet, or is surplus to, year 1 targets.

Farm Name	Rainfall (mm)	Stocking Rate over effective farm area	%Total LUC classes 4-7	%Total LUC classes 6-7	Reduction kg N/ha/yr needed to meet year 1 target.	Surplus kg N/ha/yr at year 1
Barrow	1200	2.7	12.9	6.4	1	
Glenbrook	1865	2.2	23.9	12.0	6	
Flockhouse	900	3.2	29.1	14.6		6
Tutu Totara	1141	2.6	19.8	9.9		9
Stoney Creek Partnership	1300	2.2	54.6	24.6	13	
Jala Enterprises	2300	2.5	80.6	40.3	11	
Windwood farm	1500	2.0	37.3	18.7	4	
Muskit Enterprises	1300	3.0	91.0	45.5	18	
Waka Dairies	1200	3.3	0.0	0.0	11	
Janssen	1718	2.6	65.4	32.7	9	
Johnston	837	3.3	64.6	32.3	9	
Byreburn	883	3.4	13.8	6.9	3	
Hokio Farm	1040	2.5	0.0	0.0		0
Whirokino Farm Ltd	890	2.4	53.2	53.2	2	
Moutoa M Farm	1000	3.4	0.0	0.0	3	
Martyn	890	2.4	0.0	0.0		13
Ivo Farms	970	1.7	28.5	14.3		9
Koot	875	2.6	8.0	4.0		7

97. The effect of the mitigation options recommended to farmers are understandably variable and will depend on individual farm rainfall, LUC, and the extent to which the farm has implemented best practice.

Table 12. Summaries of the nitrogen reductions required to meet year 1 targets and the recommended mitigations and their respective contributions toward achieving the targets.

Farm	Reduction to meet year 1 target	Recommended mitigation – high cost effectiveness	Effect KgN/ha/yr	Recommended mitigation – medium cost effectiveness	Effect KgN/ha/yr
Barrow	1	Off farm grazing (200 cows) Maize silage	9 2	Bridge Fence waterways	0.6 0.2
Glenbrook	6	N Inhibitors Low rate effluent application	5 2.6	Reduce cows, supplement, urea, install travelling irrigator for effluent	1 1.6
Stoney Creek	13	Reduce Urea Fence waterways Extend effluent area	3.5 2.5 1	Off farm winter grazing (all cows)	3.5
Jala	11	Off farm winter grazing (145) Reduce Urea Fence/culvert waterways	4.5 3 1.5		
Windwood	4	Fence and culvert waterways, troughs	2	Off farm winter grazing (76) N inhibitors	1 1
Muskit	18	Reduce Urea Fence waterways	4 2	N inhibitors Off farm winter grazing (345)	3 2
Waka	11	Reduce Urea Fence waterways Incorporate support block into N loss calculations*	4 1 ?	N inhibitors Off farm winter grazing (all) Reduce cows by 100 to 700	4 3 3
Janssen	9	Off farm winter grazing another month (190) Reduce cows to by 30 to 350 Incorporate support block into N loss calculations*	3 2 ?		
Johnston	9	N Inhibitors Reduce Urea Avoid urea use in winter	5 3 2	Reduce irrigation Increase effluent area	3 ?
Byreburn	8	N Inhibitors Avoid urea use in winter	3 1	Extend effluent area Reduce urea	7 1kg for every 10kg N
Byreburn With support block	-1	N Inhibitors Avoid urea use in winter	3 2	Extend effluent area Reduce urea	7 1kg for every 10kg N
Pencoed	-1	Review fertiliser timing and amount Reduce N input by switching potatoes and maize in crop rotation	1 Not assessed**	Do not winter graze dairy cows	1
Hokio	0	N Inhibitors Reduce urea use	5 1		
Whirokino	2	N Inhibitors Reduce urea use	3.6 1		
Moutoa	3	N Inhibitors Increase effluent area and reduce urea use	6 2		

* The effect of their support block was not modelled as the farmers only mentioned a support block after their reports were completed. Waka Dairies support block is 50ha and Janssen's is 120ha.

** This was not assessed because the suggestion was made by Andrea Pearson from the Foundation for Arable Research after the analysis had been completed and further analysis was outside the consultant's brief.

The implications of FARMS on intensive farms

P-Loss and faecal bacteria

98. Preventing stock from entering water and preventing dung and urine washing directly into waterways is the principal means of limiting phosphorus, faecal, and sediment contamination of surface water.

99. Fencing, culverting, bridging, and placement and design of tracks and raceways are the principal means to achieving this. Existing commitments under the DSCA account for much of what is required, although with respect to fencing the estimate is not a precise one. Manderson and Mackay (2008) stated the DCSA and POP definition was difficult to apply in practice and so it is possible the fencing required has been inconsistently recorded by consultants. It is reasonable to say though that the fencing of streams, using two or three wire electric fences, will be straight forward. Even allowing for some inconsistent recording, and apart from Muskit Enterprises who have recently converted a standard sheep and beef unit to dairying, very little individual farm fencing is outstanding.

100. Four bridges, in addition to DCSA obligations, are required on four farms. On one of these farms the bridge, estimated to cost $300,000, would give access to about 1.5ha of grazing land. On two other farms, the bridges would gain access to 3ha and 13.5ha at an estimated cost of $280,000 and $70,000 respectively. On the fourth farm the quoted cost of the bridge was $45,000 and would be used twice a month (the farmer in this instance re-routed the cows). The DCSA definition of crossing no more than twice weekly does not take into account herd size. It has been noted by Sheppard Agriculture (p125) that there is a difference between 200 cows crossing three times a week and 1000 cows crossing twice a week. The former would need to comply with the DCSA whilst the latter would not.

101. The requirement for bridging in relation to both cost/benefit and the potential for faecal contamination needs to be better reconciled and understood. At present one farm would need to spend about $300,000 on a bridge to access, for grazing, 1.5ha twice a month with 200 cows. A stream in the upper Manawatu catchment however, that has at least six crossings with herd numbers ranging from 170 to 288 (dairy discharge consent data, Horizons Regional Council), may have in excess of 38,000 cow defecations made directly into it each year (estimation based on data in Manderson and Mackay (2008), page 81, and the assumption of a similar number of cow crossings as stated in their example).

102. Farmers commented to me that installing culverts in streams will cause erosion when the stream floods, sloughing off weed and blocking them. There is the potential for this to happen although it is likely to be relatively small as there are currently many culverts already installed on farms with the benefits to the operation of the farm presumably outweighing any potential liability. However, two ways of alleviating the possibility of this occurring is fencing and planting and installing the correct size of culvert. Plant cover will significantly reduce weed growth and suitably sized culverts will allow greater margin for dislodged weed to pass through.

Farm Dairy Effluent (FDE) management

103. A recent advance in improving the management of FDE is practicing “deferred irrigation”: That is, applying the effluent to land to no more than the depth of the soil moisture deficit, thus preventing hydraulic pressure forcing the effluent below the pasture root zone and its loss to ground water. Preventing ponding of irrigated effluent has been the measure for achieving deferred irrigation and the technique requires a capacity to store effluent generally more than most farms currently have (the assessment in the FARMS Workbook (2007) did not specifically cover this; it was limited to whether there was more than two days of storage). A consent condition prohibiting ponding of irrigated effluent has been consistently applied for about fifteen years and the majority (about 75%) of FDE discharge consents have this condition.

104. All new FDE discharge consents now require the sealing of effluent ponds and sufficient storage to avoid the need to irrigate when the ground is saturated. These requirements have been introduced within the last 12 months and cover about 10% of total FDE consents granted.

105. Some test farms applied a similar amount of nitrogen fertiliser to their effluent block as they did to the rest of the farm. Apparently this is done without conscious thought as to whether it is necessary – that is, a traditional practice. Sound nutrient management advice would in part discourage this; however the knowledge of having to meet permissible N-loss targets would prevent it.

106. Most of the test farms need to make improvements to their FDE systems to be compliant with their resource consents and therefore the DCSA and the POP.

Nitrogen loss

107. Manderson and Mackay (2008) (p28) stated they expected most intensive farms to have little difficulty complying with the N-loss limits. However, they state exceptions "…may include ultra-intensive operations, new intensive land uses venturing into marginal landscapes, and farms with particular high-risk landuse/environment combinations (eg. high rainfall + coarse shallow soils + low capability land + few tree/redundant areas + high stocking rates)".

108. The results of this year's test farms support the view expressed above. The main factors driving the Overseer estimates of total N lost from the farm are rainfall, stocking rate, fertiliser input, and supplementary feed imports. LUC determines what the N-loss target will be for each farm. It is the combination of these factors rather one factor alone that makes for a challenging situation. Thus, a worst-case scenario would be one where rainfall, the proportion of LUC IV or greater, stocking rate, fertiliser use, and feed imports, are all high. Using the criteria of rainfall 1200mm or greater, and the percentage of LUC class IV or greater being more than 60%, **M. Clark** has estimated number of properties that meet these criteria (Table 13). These criteria were chosen based on the test farms shown in Tables 9 and 11 that will not meet the year 1 permissible N-loss targets after implementing the most cost effective mitigation options recommended. This number is not exact because of the other factors driving N-loss that we cannot generically quantify. For **M. Clark's** explanation as to how the criteria were applied to derive the number of properties affected please refer to **Appendix 2**.

Table 13. Number of properties with annual rainfall 1200mm or greater, and LUC class IV or greater, within priority catchments

Property size (ha)	Total number of properties	Number of properties that meet the criteria
0.02 to 360	424	141
>50	214	67
>60	184	56
>70	157	48

109. Farms in these situations can implement recommended mitigation options to achieve between 56% and 82% of the amount they are required to lose to meet year 1 permissible N-loss targets. Some farms, to reach full compliance, if they were to remain farming conventionally, would need a substantial change to their current operation. For example, shifting all the cows off the farm in the winter, building a herd home,

purchasing or leasing a support block, reducing cow numbers, or some combination of these. An alternative to this could be changing from a conventional system to a bio-dynamic or organic system. Such a change would take time and imposes greater disruption than making improvements to a conventional system. It is acknowledged though, that the law of diminishing returns would apply in that, whilst the greatest reduction is required in year 1, the subsequent milestone years, based on current technology, will likely be increasingly more difficult.

110. Opting for farm scale LUC mapping was clearly advantageous to some farms. There does not appear to be an obvious pattern as to which farms are likely to benefit from which scale of mapping. The expertise of Sheppard Agriculture proved beneficial to Windwood Farm where they judged farm scale would re-classify class VI land to a lower class therefore making a significant difference to this farms permissible N-loss target.

111. The need for accurate farm records to be kept was identified by the consultants. Some farms were exemplary in this and others very poor. It is a critical facet to the success of the methodology and therefore the improvements to water quality it is intended to make and I discuss this more fully under Lessons Learnt.

112. Intensive farms in sand country priority catchments have presented a different challenge. The recently revised Land Use Capability Survey Handbook (Lynn et al. 2009[3], page 86) comments that "Soil conservation measures, irrigation, farm drainage, stone removal, and fertiliser applications are examples where technology can be used to modify or remove existing physical limitations on individual farms. ***The Land Use Capability assessment assumes that such improvements have been carried out.*** LUC assessment can also be adjusted by major schemes that permanently change the degree of the limitation, such as large scale irrigation, drainage, or flood control schemes." If it were considered that the Johnston farm near Foxton had overcome a major limitation (soil moisture deficit) by permanent irrigation, the area of land that would be identified is the class VIs4 land covering, at regional scale, 51ha. If this land were adjusted to class IV, increasing that class overall from 60ha to 111ha, and reducing the area class VI by the same amount from 50ha to 19ha, it raises the year 1 permissible N-loss target from 16.4 to 17.6kg N/ha/yr.

113. Each report has consistently identified similar measures to mitigate N-loss although to varying effect depending on the farm situation.

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3 Lynn IH, Manderson AK, Page MJ, Harmsworth GR, Eyles GO, Douglas GB, Mackay AD, Newsome PJF 2009. Land Use Capability Survey Handbook – a New Zealand handbook for the classification of land 3rd ed. Hamilton, AgResearch; Lincoln, Landcare Research; Lower Hutt, GNS Science. 163p.

Farmer comments on the recommended mitigation options

114. Some farmers commented that wintering off cows just transfers N-loss the problem. However if this occurs within the same priority catchment this is not so for three reasons:

- The N-loss targets for each farm have been derived from a whole priority catchment basis (refer to the evidence **J. Roygard**).
- It assumes it is a net addition to stocking rates and this is unlikely – rather they will be displacing an existing grazing regime.
- If cows are transferred to a non-priority catchment within the Horizons region it is presumed at present these can currently sustain higher levels of N-loss, if in fact it results in higher a stocking rate.

115. One farmer commented that successful grazing off depends on availability and quality and this varies between years. This is a fair point and will add a degree of complexity into farm business planning. Mostly though, the imperative for it to work successfully will likely cause the farmer to seek reliable grazing off arrangements.

116. One farmer said that options for managing nitrogen applications and amounts are easier to implement at some times of the year than others. Spring he said is a critical time for the cows and therefore the application of N very important. Farmers have not previously had to consider, with respect to an N-loss target, the timing and amount of N applied. The point made is therefore understandable and some management adjustments will be needed to prioritise use in the knowledge there may be an N-loss targets to be met.

117. Farmers have expressed doubt about the effectiveness of N-inhibitors in the North Island. The consultants completing the FARMS test farms applied a conservative estimate in their OVERSEER modelling and, while this might be acceptable at this point, there does appear some uncertainty. This uncertainty has resulted in a joint research project involving the Ministry of Agriculture and Fisheries, the dairy industry, fertiliser companies, and greenhouse gas interests, embarking on a $10 million dollar research programme (www.maf.govt.nz/mafnet/press/2009/050809-nitrification-inhibitor-research.htm). Specific questions on nitrification inhibitors will be answered by AgResearch scientists.

118. Farmers said having time to implement mitigation options by working with them (and by implication all farmers involved) and providing consistent and sound advice is critical. I agree whole-heartedly with this view and it has been with this in mind that Horizons has recently appointed a Rural Industry Advisor.

119. Not a comment related to the mitigation options, but a valid concern nonetheless is the affect on the farmer's farm equity if they cannot get the production they anticipated.

Lessons learnt

120. Manderson and Mackay (2008) (Part 4, p47) and Sheppard Agriculture (2009) (p 125) raised a number of matters to improve the FARMS methodology.

i. The FARMS Workbook (2007) was identified as not being user friendly and contained several errors. It has been revised in the manner recommended (FARMS Workbook 3 (Manderson 2009b)).

ii. FDE discharge to land must comply with separation distances protecting public facilities, residences, and features of importance (e.g. waterways, wetlands, archaeological sites). Some of these distances were incorrect in the FARMS Workbook (2007) and have been corrected in the new version of the FARMS Workbook 3 (Manderson 2009b).

iii. Farm offal pits have been removed as a checklist requirement from the FARMS because of the confusion and impracticality of the current wording. These still remain as a permitted activity subject to certain conditions.

iv. Definitions of waterways and waterbodies. The definitions in the FARMS Workbook (2007) caused confusion. These definitions have been revised in the FARMS Workbook 3, page 8 (Manderson 2009b).

v. Definition of feed storage and feed out areas. These have been comprehensively re-defined in the FARMS Workbook 3 (Manderson 2009b), sections 8.11 to 8.16.

vi. Definition of Residential plots. This was poorly defined in the FARMS Workbook (2007) and has been corrected in the FARMS Workbook 3 (Manderson 2009b), page 8.

vii. Farms that are required to complete a FARMS. Defined in the FARMS Workbook 3 (Manderson 2009b), page 3. This includes definition of support blocks.

viii. Regional scale LUC mapping versus farm scale LUC mapping. What scale can be used has been clarified in section 3.1 (p7) of the FARMS Workbook 3 (Manderson 2009b).

ix. Education of industry participants. Informing and up-skilling industry representatives on a regular basis will be undertaken. Consistency of application of the FARMS is critical to its success.

x. Farmer education. It is important farmers who farm intensively in the priority catchments are kept informed about the FARMS. When and what is required, who are accredited persons for the completion of a FARMS, how the internal Horizons process will work, what they will cost, how they can get assistance through the process, how compliance will be monitored, and how they, the farmers, can help with that.

xi. Bridging. Sheppard Agriculture (2009) makes the point that bridging is the most expensive infrastructural requirement for keeping cows out of waterways. Manderson and Mckay (2008) say too, that little research is available to quantify the input, and therefore the risk to contact recreation, of faecal bacteria to water. The expert evidence of **K. McArthur** does not support this view and she states "*E. coli* contamination during the Manawatu low flow investigation (Map 15) showed that several tributaries of the upper Manawatu were unsuitable for contact recreation at the time of the survey. Elevated *E. coli* concentrations at low flows indicates these tributary streams were subject to direct faecal inputs from either stock crossings or stock access to the waterways, adversely affecting the contact recreation value in these tributaries."

xii. The number of cow crossing points within the priority catchments, their frequency of use, by how many cows, is not known. Whether waterways will be required to be bridged should be assessed on a case by case basis taking into account the number of crossings within that Water Management Zone, how frequently they are used, by how many cows.

xiii. Seasonal variation in farm OVERSEER input data. Sheppard Agriculture and farmers have raised the issue of seasonal variations in their fertiliser use. This is understandable from a practical farming point of view as very few years are the same. There are three possible solutions: Firstly, where several years of data are available OVERSEER modelling should be based on these to be more assured the results match reality. Secondly, where several years of record are not available, or the farmer wants to intensify, then anticipated maximum data should be used. A third approach could be that an "on average" appraisal is provided. That is, in a "good" year the farm achieves a credit for a good result which can be banked in the event of a "bad" year. Thus, on average, say on a five yearly basis to conform with the milestone N-loss target periods, the farm achieves its overall target. Farmers could have the choice, but fundamental to any choice being successful is the accuracy of farm record keeping and provision of this annually would need to be a consent condition.

xiv. OVERSEER attracted a number of comments from both Manderson and Mackay (2008) and Sheppard Agriculture (2009). Some of these issues which I address under "the principal solutions" below and others are discussed in **S. Legard's** evidence.

xv. Input data to OVERSEER. The accuracy of data required was found wanting in a number of cases – too many for the issue to be dismissed as occasional. That said some of the farm record keeping was exemplary. The consultants found discrepancies to varying degrees between owner information, manager information, and fertiliser representative information. Some farms had little or no record of how much fertiliser had been applied where, when, and in what quantities. Purchase of fertiliser from different companies compounded the problem of tracking this information.

xvi. The principal solutions are:

- HRC will devise protocols for the collection, verification, and competency of data input to OVERSEER. Some of these protocols have been recommended by Manderson and Mackay (2008) (Part 4, p52).
- The FARMS will require OVERSEER printouts of input data (as suggested by Manderson and Mackay (2008)). These can be checked against, for example, fertiliser records, the keeping of which can be a condition of consent.

Where FARMS apply and when

121. Table 14 sets out the Water Management Zones that FARMS will apply to and the dates they are required by.

Table 14. Water Management Zones and dates FARMS are required.

Catchment	Water Management Zone	Date the rules of the Plan come into force
Mangapapa	Mana_9b	1 April 2009
Mowhanau	West_3	1 April 2009
Mangatainoka	Mana_8a Mana_8b Mana_8c Mana_8d Mana_8e	1 April 2010
Upper Manawatu above Hopelands	Mana_1a Mana_1b Mana_1c Mana_2a Mana_2b Mana_3 Mana_4 Mana_5a Mana_5b Mana_5c Mana_5d Mana_5e	1 April 2011
Lake Horowhenua	Hoki_1a Hoki_1b	1 April 2012
Waikawa	West_9	1 April 2012
Manawatu above Gorge	Mana_6 Mana_9a Mana_9c	1 April 2013

Catchment	Water Management Zone	Date the rules of the Plan come into force
Other south-west catchments (Waitarere and Papaitonga)	West_7 West_8	1 April 2013
Other coastal lakes	West_4 West_5 West_6	1 April 2013
Coastal Rangitikei	Rang_4	1 April 2014
Mangawhero/Makotuku	Whau_3b Whau_3c Whau_3d	1 April 2015

Potential cost of completing a FARMS

122. Manderson and Mackay (2008) estimated the cost of a FARMS to be about $1,500 (minimum), $2,300 - $5,000 (medium) and at least $10,000 (comprehensive). Our experience suggests $1,500 for a minimum level report would be for a comparatively simple farm operation likely to meet their permissible N-loss targets and using a regional scale LUC map. A medium level FARMS where the targets cannot be met in year 1, presenting sound mitigation options with costs, with a farm scale map, would be between $2,000 and $5,000 (including) depending on the complexity of the farming operation and availability of accurate farm records.

The processing of a FARMS upon completion

123. The completed FARMS is a farmers application for consent (FARMS Workbook 3 (Manderson, 2009b). This documentation is in effect a package application for one or more activities, which will be individually listed with conditions. In so far as the farmer is concerned though, they have made one application. For example, where stock exclusion from a waterway has been identified as needed, a condition will be stated where on the farm this is and when remedial measures are to be implemented by. Where a reduction in N-loss has been identified, the mitigation option(s) chosen by the farmer will be listed as the consent condition(s). Similarly other conditions will cover water takes if they exceed the daily use limits prescribed in the POP.

124. Horizons processing of the consent will be “fast tracked” if it has been completed properly by a qualified person. A qualified person will need to have passed a senior OVERSEER certification course and be able to demonstrate competency in farm management systems. A register of these people will be compiled by Horizons and made available to farmers. “Fast tracking” means Horizons consent staff will check whether the application has been completed by a qualified person and if so, check the

Workbook requirements have been met, determine what activities require conditions, specify these if they have not been by the farmer, check the mitigation options listed will achieve N-loss targets, and then grant the consent. Again with the proviso that the application has been satisfactorily completed, processing the consent should take no more than two hours whereas, by comparison, a farm dairy effluent discharge consent currently takes between six and eight hours to process. Applications that have not been completed by a qualified person will be sent to a qualified person to be peer reviewed. This will primarily focus on the estimation of current N-loss using OVERSEER and an evaluation of N-loss mitigation options where these are necessary.

4. CONCLUSION

125. It is important to emphasise that these farms were selected rather than randomly chosen. Therefore the results cannot be extrapolated to make inferences about all intensive farms. Such inferences could only be made if the farms had been randomly chosen. The results do indicate though, which farming operations are likely to comfortably achieve compliance with the POP Rule 13-1 and those that will have considerable difficulty complying.

126. The FARMS is an output based environmental assessment of the whole farm focusing on the loss of contaminants from the farming operation. It puts much needed context around the assessment of farm activities that have a potential adverse environmental effect. It has the flexibility to allow individual farm solutions where environmental improvements are required. It packages information for the farmer some of which may have been unknown or not previously considered either relevant or useful – for example LUC mapping, nutrient budgets, management of FDE as a nutrient, and the amounts, timing, and placement of fertiliser use. It provides an opportunity to engage and work constructively with farmers to achieve targets.

127. Under the current system some individual on-farm activities require resource consent and these are dealt with in isolation to any other farm activity. Many other activities have “permitted activity” status under regional rules which are rarely known about unless it is to do with a water take. The FARMS obliges by encompassing all regulatory requirements bringing these to the attention of the farmer, which in turn sets the scene for negotiating outcomes. For example: where a raceway on one test farm sloped towards a watercourse, re-shaping 500m of the raceway would have been very expensive and instead a series of earth weirs placed in the watercourse (which flowed into a stream) to act as sediment and nutrient traps, at a fraction of the cost, was recommended to the farmer as an alternative solution.

128. It causes the farmer to keep accurate farm records. Each of the consultants completing a FARMS had difficulty obtaining accurate information and because there may be a regulatory requirement to be met, which can have serious implications for the farmer, accuracy of information will be paramount.

129. It confronts often contentious and difficult issues around contaminants entering water, particularly that of N-loss. Currently nutrient budgets, an important step forward, are produced for farmers, in the main, by fertiliser companies. Although these budgets produce an N-loss number, alone, it has no context around any environmental adverse effect. It has relevance only to the N conversion efficiency which is a production index. The proposed N-loss targets provide the environmental context. It has caused farmers, the consultants involved and, not least, the regional council to understand the implications of these data: that is, to what extent, how, at what cost, and in what order, can N-loss be mitigated.

130. The reaction from the owners of the FARMS properties has been neutral to positive. They have been keen to learn of the implications to them of the POP. They recognise that good water quality is important and want practical cost effective mitigation options. Where targets are challenging for them they want time, good advice and someone to work with them toward making the necessary improvements. Some though, are concerned the threat FARMS may pose to the economic viability of their businesses.

131. In my opinion the Farmer Applied Resource Management Strategy is an effective and constructive way of engaging with farmers farming intensively in the priority catchments. It will be a successful tool in reducing the loss of contaminants off these farms. The value of the testing has been immense, particularly in understanding which N-loss mitigation options are most effective and which farms will be most challenged in meeting the permissible N-loss targets. The latest version of the FARMS workbook, which incorporates the consent application and its reference guide, is a very functional and informative document. I firmly believe the Farmer Applied Resource Management Strategy, with the revised FARMS Workbook 3, as set out under Rule 13-1 of the Proposed One Plan, be retained as the key tool to improving water quality in the priority catchments.

Peter Taylor
August 2009

APPENDIX 1

Farmer Applied Resource Management Strategy Reports Reference List

LandVision, 2009a. FARM Strategy Summary Report. Prepared for Horizons Regional Council by LandVision Ltd., Wanganui.

LandVision, 2009b. Moutoa M Dairy Farm, Landcorp, Foxton. FARM Strategy for Horizons Regional Council. Prepared by LandVision Ltd., Wanganui.

LandVision, 2009c. Ivo Farms, C & B Jansen, Forest Road, Kimbolton. FARM Strategy. Prepared by LandVision Ltd., Wanganui.

LandVision, 2009d. Martyn Farm, Taylor Road, Sanson. FARM Strategy. Prepared by LandVision Ltd., Wanganui.

LandVision, 2009e. River Farm, Whirokino Farm Ltd., SH1, Foxton. FARM Strategy. Prepared by LandVision Ltd., Wanganui.

LandVision, 2009f. Hokio Farm, G & C Kane, Hokio Beach Road, Levin. FARM Strategy for Horizons Regional Council. Prepared by LandVision Ltd., Wanganui.

AgResearch, 2009a. FARM Strategy - Overview Report. Report prepared for Horizons Regional Council by Bob Longhurst, AgResearch Ltd.

AgResearch, 2009b. FARM Strategy – Farm 1: Dairy conversion – Norsewood. Report prepared for Horizons Regional Council by Bob Longhurst, AgResearch Ltd.

AgResearch, 2009c. FARM Strategy – Farm 2: Irrigated beef finishing unit – Oringi. Report prepared for Horizons Regional council by Bob Longhurst, AgResearch Ltd.

AgResearch, 2009d. FARM Strategy – Farm 3: Intensive dairy – Fielding. Report prepared for Horizons Regional council by Bob Longhurst, AgResearch Ltd.

AgResearch, 2009e. Farm Strategy – Farm 4: Intensive mixed cropping – Marton. Report prepared for Horizons Regional council by Bob Longhurst, AgResearch Ltd.

AgResearch, 2009f. FARM Strategy – Farm 5: Dairying under irrigation – Foxton. Report prepared for Horizons Regional council by Bob Longhurst, AgResearch Ltd.

Sheppard Agriculture, 2009a. Reporting the effect and implications the One Plan and FARM Strategy has on individual dairy farm properties in the Tararua District. A case study approach. Prepared by Rachel Rogers, Sheppard Agriculture Ltd.

Sheppard Agriculture, 2009b. Reporting the effect and implications the One Plan and FARM Strategy has on individual dairy farm properties in the Tararua District. A case study approach – Further Analysis. Prepared by Rachel Rogers, Sheppard Agriculture Ltd.

DairyNZ, 2009. Jack & Rosemary Koot's Dairy Farm, Pukepuke Road, Oroua Downs. FARM Strategy. Prepared by Scott Ridsdale & Mike Bramley.

APPENDIX 2

Estimation of number of properties, within priority catchments (Table 13.1, POP), with more than 1200mm rainfall per year and more than 60% LUC class IV and higher.

Using the Land use / Land use capability layer (Clark and Roygard, 2008), I selected all of the Dairy landuse within LUC classes 4,5,6,7 and 8. I then created a new layer called Dairy_LUC4+. I then took the Rainfall Median 1978-2007 raster layer (Tait and Sturman, 2008) and selected all grids where median rain fall was greater than 1200mm/yr. I then clipped the Dairy layer by the Rainfall to select out pieces of Dairy where LUC was greater than or equal to 4 and median rainfall was greater than or equal to 1200mm/yr.

With the newly created layer I intersected the cadastral information and created a layer with which I had the cadastral parcel containing the specified dairy land. I used this data to select the Valuation New Zealand (VNZ) number to get a property boundary (it was assumed that parcels with the same VNZ number formed a property). The parcels with the same VNZ number were merged together to form property boundaries containing Dairy that met the criteria. This created the 'property layer'. The area of Dairy meeting the criteria was added into the attribute table for each property.

I then intersected the newly created property layer with the Water Management Sub-zone boundaries and determined which properties were within the target catchments for the FARM Strategy. If a property was more than 50% within a target catchment it was included in the analysis. For the areas of Dairy meeting the criteria, but where the VNZ number was non-existent, I used landowner information to select the property within the priority catchments. There were only 4 properties that could not be determined after this analysis so for these properties the initial parcel intersected was used.

I then calculated the total area of the property and used the area in Dairy that met the criteria to determine a percentage of the total property that would potentially have issues meeting the Rules in the FARM Strategy.

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