BEFORE THE CANTERBURY REGIONAL COUNCIL

IN THE MATTER OF the Resource Management Act 1991

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IN THE MATTER OF Water permit applications by Simons Pass Station Limited and Simons Hill Station Limited, Rosehip Orchards New Zealand Limited and High Country Rosehip Orchards Limited

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STATEMENT OF EVIDENCE OF MELISSA CLARE ROBSON DATED 18 NOVEMBER 2009

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Qualifications and experience

1. My name is Melissa Clare Robson and I am an environmental scientist.

2. I recently joined Ryder Consulting Limited. Prior to that appointment I was employed by GHD for a period of 18 months. I hold a Bachelor of Science (Honours) in Tropical Environmental Science conferred by the University of Aberdeen, a Masters of Science in Integrated Water Management and Advanced Irrigation conferred by Cranfield Institute of Water Management at Silsoe, and a Doctorate in Plant and Soil Science conferred by the University of Aberdeen, the Aberdeen Centre for Organic Agriculture and the Scottish Agricultural College.

3. I have completed the UK Fertiliser Advisers Certification & Training Scheme (FACTS)**:** An independent, non-statutory certification scheme for advisers in plant nutrient management. I have also completed the Fertiliser and Lime Research Centre Intermediate and Advanced Sustainable Nutrient Management Course.

4. I have 10 years of post graduate experience and since 2004 have been working specifically to reduce diffuse pollution from agriculture both in a regulatory role and through voluntary schemes. In 2004 – 2005 I worked as an Agricultural Environment Officer for the Environment Agency working specifically with farmers to reduce nitrate losses and meet regulations with respect to nitrate losses, groundwater protection, slurry, silage and fuel oil, pesticide use and containment and general pollution prevention. During this time I conducted a catchment campaign aimed at reducing nutrient pollution from dairy farmers.

5. At the same time I began working on the Environment Agency's 'Landcare' project. This project was initiated to address the degradation from diffuse agricultural sources that was evident in the Avon Catchment, a chalk stream system regarded as one of the finest in Europe and one that is subject to numerous sites of special scientific interest, special areas of conservation and other designations for both flora and fauna characteristic of this low nutrient environment. The chalk aquifer underlying the catchment is a key water source in the area and supplies water to the cities of Bournemouth and Bath.

6. From 2005 to 2008 I worked full time on the Landcare project, determining and addressing diffuse pollution problems in the catchment and providing on farm advice and direction on methods, options and planning mechanisms to reduce

farm losses. In 2006 the Landcare project format was adopted and rolled out as part of a UK-wide project to address diffuse pollution from agriculture as part of the England Catchment Sensitive Farming Delivery Initiative. This initiative is now a principal tool to address diffuse water pollution from agriculture used to deliver water quality improvements required under the European Union Water Framework Directive.

7. Since February 2008 when I was employed with GHD I worked in New Zealand, predominantly on the Upper Waitaki Water Quality Study to assess the cumulative effects of increased nutrients on water quality from agricultural intensification. I have worked as the project leader for on-farm mitigation strategies to reduce soil and nutrient losses and developing farm management planning strategies to achieve environmental targets. I wrote the mitigation toolkit with assistance from Laura Buckthought[1], from GHD Ltd. This toolkit is designed to illustrate that the nutrient thresholds set in the WQS can be met through on-farm mitigation, to offer land managers guidance for formulating a Farm Environmental Management Plan to deliver nutrient mitigation required by the WQS, and to provide a suite of options for reducing diffuse pollution from site specific environmental risks identified on their farms.

8. Since May 2009 I have been involved in putting together property specific Farm Environmental Management Plans and in this time I have worked on full FEMPs for nine properties and have given limited assistance in the formulation of partial FEMPs for a further 20 properties in the Upper Waitaki Catchment.

9. In preparing this evidence, I acknowledge that I have read the code of conduct for Expert Witnesses in the Environment Court Consolidated Practice Note (2006). I agree to comply with this Code of Conduct. This evidence is within my area of expertise, except where I state I am relying on what I have been told by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of evidence

10. I have been asked by Simons Pass Limited ("SPSL"), Simons Hill Limited ("SHSL"), Rosehip Orchard New Zealand Limited (“RONZL”) and High Country Rosehip Orchard Limited (“HCROL”) to prepare and present evidence on their Farm Environmental Management Plans.

11. My evidence covers the following topics:

[1] Environmental scientist with GHD Ltd. BSc Hons Environmental Science. Honours thesis on nitrate pollution of the Ashburton River.

(a) The purpose and structure of the Farm Environmental Management Plans

(b) Building a FEMP and data collection for SPSL/SHSL/RONZL/HCROL plans

(c) Site specific issues and FEMPs for SPSL/SHSL/RONZL/HCROL

(d) Response to concerns raised in Section 42a Officer's Reports

(e) Response to concerns raised by submitters

Purpose and structure of the FEMPS

12. The FEMPs have been written to serve two purposes:

(a) To ensure that the proposed farm system can meet the nutrient requirements set out by the Water Quality Study, and

(b) To identify and mitigate other farm specific environmental risks that arise from the inherent characteristics of the farm or from the proposed farm system and its management.

13. These farm specific risks include uncontrolled discharges from the agricultural operation that are not included in the farm nutrient budgeting modelling but that may still have and environmental effect.

14. Each FEMP is divided into six principal sections:

(a) Introduction

(b) Farm description, describing the farm location, soils, climate and topography.

(c) Environmental context, describing the property's receiving environments, both in terms of the wider catchment and on-farm and local receiving environments. FEMP development section describes

(i) Mandatory Good Agricultural Practices (MGAPs) that need to be implemented across the farm, and include the overt base assumptions of the OVERSEER model[2]. This helps to validate the use of the model on the property;

[2] In the future, should an alternative model be used, the assumptions for that model would need to be specified in this good agricultural practice section.

(ii) Water Quality Study mitigation requirements and the farm's nutrient discharge allowance for both N and P; and,

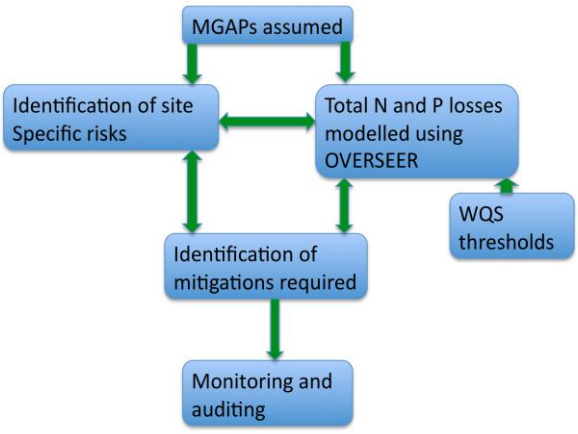
(iii) The identification of site specific environmental risks.

(d) Proposed farm system with mitigations, describes the proposed farm system with the mitigation and management measures that are required to be implemented to meet both the WQS thresholds and mitigate the identified site specific environmental risks.

(e) Farm Environmental Management Plan section describes through a series of tables and maps the mitigations, monitoring and auditing requirements of the plan. The first table lists each of the mitigation and management measures adopted along with an annotated map to highlight key mitigation locations, the second table lays out the environmental monitoring plan for the property along with an annotated map, and the third table lays out a proposed audit plan for the property that would form the basis of an annual report to ECan.

15. A schematic of the FEMP development is shown in Figure 1.

Figure 1: An overview schematic of the process of building a Farm Environmental Management Plan



Building a FEMP and data collection

16. This section of my evidence lays out the process of building these FEMPs and collecting the necessary data for the plans.

17. In developing these FEMPs, my role was to carry out a Farm Environmental Risk Assessment (FERA) on site and incorporate a suite of modelled farm systems (from AgResearch) into FEMPs for these properties. The staged modelling approach used to derive nutrient losses from proposed systems using FARMAX, OVERSEER and APSIM will be described by Mr Graeme Ogle and Dr Val Snow.

18. The Mandatory Good Agricultural Practices, Table 1, that are common to all of the FEMPs were agreed with AgResearch and were presented and agreed with the land owners or representatives during the site visit. These MGAPs have been described more fully in paragraph 20 of my principal evidence given in the first week of this hearing.

Table 1: Mandatory good agricultural practices

Mandatory good agricultural practices
Fertilisers applied according to code of practice for fertiliser use
Use a fertiliser recommendation system and account for all sources of nutrients including applied effluents and soil reservoirs accounted for
Fertiliser application applied evenly
Irrigation and effluent applied evenly
Crop, cultivation, nutrient inputs and yield records kept per farm management unit
Good design of irrigation systems
Robust irrigation scheduling
Supplement and feeding out management
Winter grazing management

19. Once the suite of viable proposed farm system options was decided upon, a site visit took place. Prior to the site visit, a desktop review was conducted. The proposed irrigation design and farm layout was overlaid onto topographic maps and soil maps to assess likely areas of environmental risk, areas where verification of information is required and possible monitoring points.

20. The initial phase of the site visit included a discussion with the farmer as to their current practices where appropriate (to assess risks of current practices) and proposed systems.

21. The remainder of the site visit involved assessment of each management block in terms of the FERA, soil testing for compaction, and the closer examination of the local receiving environments and potential risks from proposed activities.

22. The purpose of the FERA exercise is to identify areas of environmental risk on the farm and in the farm practice. Some risks pertain to inherent risks on the farm and others arise from the way that the farm is managed. Additionally, some risks may be answered immediately such as 'are soils left bare over winter?' and others will require a cursory investigation such as 'are there compacted, consolidated or capped soils?'

23. There are nine sections in the FERA covering soils, cropping, effluent/infrastructure, fertiliser, water, chemicals, biodiversity/natural features[3], stock nutrient losses and track management/runoff. The guide questions given in the FERA are not exhaustive and should other issues become apparent during the site visit these should be included. For example, if a farm dump is found to be sited next to a bore hole, or a field silage pit is found to be sited next to a watercourse, these are clearly risks and would need to be recorded and mitigated.

24. In terms of soil testing, a visual inspection was conducted of the soil surface to assess for soil surface compaction and soil penetrometer probings and verification soil pits were dug on each soil type to more closely examine the nature of any compaction or consolidation and also to assess soil texture. This testing was necessary to gain an understanding of the current soils conditions and the likely risks when intensified.

25. Local and on farm receiving environments were identified on maps and visited and their current condition assessed in terms of impacts of current farming practices.

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[3] An ecological study was done on all 6 properties and is presented by Dr Ryder

26. The outcomes of the FERA and possible consequent mitigation measures were discussed with land owners or their representatives.

27. Once the proposed farm system and the site specific environmental risks had been identified, a list of mitigation measures was drawn up and an annotated map created to indicate the locations of the key mitigation measures. For each of these individual mitigation measures a monitoring/auditing options is given. The proposed suite of farm systems are modelled and a report of the inputs and outputs of the models are generated and attached in the appendices of the FEMP.

28. An environmental monitoring plan was drawn up indicating the type, location and frequency of monitoring and the parameters to be tested, and an annotated map was created to show monitoring locations. The monitoring plan also includes triggers for each monitoring parameter where appropriate and immediate contingency plans should the trigger be exceeded. The inclusion of the triggers is an important addition to the FEMPs, as it provides a point of reference or action for the monitoring programme. Where triggers are exceeded, the immediate contingency plans laid out should be implemented while a 'root cause' analysis is carried out. Any further mitigation measures to be adopted as a result of monitoring should be added to the FEMP.

29. The simple 'root cause analysis' process is laid out below:

(a) Is the current mitigation option implemented correctly?

(i) No – Implement and monitor

(ii) Yes – to (b)

(b) Has anything changed in the farm system?

(i) Yes – remodel and monitor

(ii) No – to (c)

(c) Have there been abnormal conditions[4] at the time of trigger breach?

(i) Yes – continue monitoring to see if trigger breach continues

[4] Abnormal conditions include extreme weather events and failures of infrastructure such as the effluent storage facility.

(ii) No – Seek advice of suitably qualified person to further investigate root cause and suggest appropriate further mitigation.

(d) Finally, an auditing plan was proposed. The auditing process allows both the farm operator to illustrate, and other interested parties to have confidence that the management practices and mitigations planned for the farm are being implemented. In addition, the audit shows that there is a mechanism for the adaptive management of the property should the chosen mitigation or management not perform to expectations as it lays out actions to be taken in the case of non-compliance.

30. An annual audit is proposed, and requires both external and in-house input. The annual audit should be completed and submitted to Environment Canterbury by the end of July each year.

31. In terms of compliance with the WQS thresholds, SHSL and SPSL, RONZL and HCROL have collectively decided to assess compliance based on losses modelled using the Highly Developed setting in OVERSEER and to discard activities that do not meet thresholds at Highly Developed. The highly developed setting assumes no immobilisation of N into organic matter and therefore all inputs are either taken up by the plant or are lost to the atmosphere or to ground.

Individual farm plans

32. The following section describes each of the individual farm plans prepared for the properties, in terms of:

(a) The WQS receiving environment;

(b) The local receiving environment;

(c) The WQS thresholds;

(d) The proposed farm system with mitigation and

(e) The proposed monitoring and auditing plans.

Simons Hill Station

33. The proposed irrigation area of Simons Hill Station lies in the Mary Burn surface water sub-catchment and in the Tekapo groundwater sub-catchment identified in the WQS (GHD, 2009).

34. The potential local receiving environments for Simons Hill Station that are not considered in the WQS are the stretch of the Mary Burn that intermittently runs along the property boundary, the wetland in the pass between House Hill and Simons Hill and the DoC reserve on the eastern side of Simons Hill.

35. The Mary Burn water quality and ecology in the downstream reach are considered in the WQS, however the Mary Burn enters the property on the south side of SH8 from a neighbouring property – Maryburn Station and runs along the eastern border of the property, but is not continuously within the property boundary. Along this length of the Mary Burn there are spring fed channels (groundwater recharging surface water) and ephemeral channels of the Irishman Creek converging. The stream ecological value is described by Dr Ryder in his evidence.

36. The Department of Conservation wetland is located between Simons Hill and the Mary Burn. This wetland area is reported to be an important refuge for black stilt when the Tekapo River is in flood (DoC, 2007).

37. The DoC conservation area has been created covering approximately 407 ha on the eastern face of Simons Hill (DoC, 2007). The reserve contain shrublands of Matagouri, porcupine shrub, small leaved Coprosma, prostrate kowhai and *Olearia oderata* (DoC, 2007).

Simons Hill - WQS thresholds

38. A table showing the proposed whole farm losses from WQS, the WQS thresholds and the OVERSEER modelling outputs (modelling the proposed system with mitigations) is shown below. To recap, the WQS thresholds (or NDA) are derived from the proposed losses from the farming system as calculated by the WQS (not including any mitigations) minus the calculated mitigation requirements for that sub-catchment or area. For each sub-catchment, the most stringent mitigation requirement should be adopted. For this farm, the N mitigation requirements are the most stringent for the Tekapo River and the P mitigations are most stringent for the Mary Burn. These WQS mitigation requirements set Simon Hill Station's nutrient discharge allowance at 56,614 kg N per annum and 3,278 kg P per annum. A full table showing the

mitigaiton requirements for each receiving environment and the original predicted losses are given in each FEMP attached to this evidence.

Table 2: Total N and P losses modelled by OVERSEER for the proposed farming system on Simons Hill Station WQS thresholds and original WQS proposed farm losses using a Developed setting.

	Proposed losses from WQS	WQS threshold kg/year	OVERSEER modelling outputs kg/year
Total N leaching/ runoff	57,033	56,641	8,556
Total P leaching/ runoff	3,720	3,278	371

39. On a per hectare basis over the entire farm, this gives an N loss of approximately 3 kg/ha and a P loss of approximately 0.1 kg/ha. These losses are below the range quoted for typical sheep and beef farms in New Zealand of 5-20 kg N/ha (OVERSEER v.5.4.3).

40. At a highly developed setting, the modelled N losses increase as show below. This setting allows for no immobilisation of N and is therefore conservative and represents the upper bound of N losses for the systems as they are described and modelled in OVERSEER 5.3.4. As these losses are still within the WQS threshold, no further mitigation would be required should the soils become highly developed.

Table 3: Total N and P losses modelled by OVERSEER for the proposed farming system on Simons Hill Station WQS thresholds and original WQS proposed farm losses using a Highly Developed setting.

	Proposed losses from WQS	WQS threshold kg/year	OVERSEER modelling outputs kg/year
Total N leaching/ runoff	57,033	56,641	10,444

Simons Hill Station - Proposed farm system with mitigations

41. The proposed farming system on Simons Hill Station is an integrated high country system. This system utilises the irrigated area for summer grazing and finishing with the high country part of the station running predominantly merino sheep on the dryland area of the farm. The additional pasture grown under irrigation is used to support a beef finishing enterprise. This enterprise is an expansion on the system already being run on Simons Hill Station.

42. Soils - There are three soil series (excluding hill country) on Simons Hill Station; Mackenzie soils, an association of Grampian/Simons/Glenrock soil series and an association of Buscot/Sawdon/Dobson soil series. The FERA highlighted current soils risks associated with erodible soils on the property. Potential additional soils risks arise from the possibility of consolidation or compaction of soils including from trafficking soils when wet, soils left bare over winter and the potential damage of heavy stock on wetland soils.

43. The proposed management or mitigation measures are:

- ***The annual monitoring and identification of soil compaction in hydrologically connected areas and documented remedial actions taken;***
- ***No trafficking of soils when wet, and as this is not always possible, the above monitoring will identify any issues arising;***
- ***If there is insufficient time to establish a cover crop or there is concern about soil moisture on dryland areas, the surface of the soil on cropped areas should be protected over winter through leaving previous crop debris on the surface; and***
- ***The wetland soils within the DoC wetland should continue to be protected from stock access.***

44. In addition, the current practices to maintain soil moisture and ground cover, practices of principally using direct drilling, growing the fodder crops as a part of the pasture renewal process thus not mining soil organic matter levels in a few paddocks, and restriction to light grazing of winter forage crops should be maintained.

45. Stock - The proposed stock on the station are approximately 8,500 merino ewes and between 150 and 370 cattle. The FERA highlighted potential stock risks associated with the possibility of beef stock having access to the Mary Burn and any open channel irrigation races and the placement of a pivot on shallow and stony soils adjacent to the Mary Burn.

46. The proposed management or mitigation measures are:

- ***No beef stock will have access to the Mary Burn;***
- ***No stock will have access to the irrigation races; and,***
- ***On the northernmost pivot with shallower soils, an aquaflex system will be installed, deep-rooted species of grass should be grown and no cattle should be overwintered on the area.***

47. In addition, the current practices of frequently moving mobs and silage lines to reduce concentration of excreta, and reducing of stock numbers over winter should be maintained. The proposed farm system will also see virtually no winter grazing of forage crops. Forage crops will receive light grazing in autumn and again in spring.

48. Production - The irrigated area will be under a pasture mix including tall fescues, chicory and clover. Pasture production is expected to be between 12 and 13 t dry matter/ha on irrigated and fertilised land. A 70 % pasture utilisation rate has been assumed on irrigated land. The annual farm production will be in the form of the finished beef stock, the weaned calves and finished lambs.

49. Effluent/Silage - Stock will not be housed under the proposed system and therefore manure and effluent will not be collected. Grass cut for silage is wilted to > 35 % dry matter before ensiling ensuring minimal effluent production. There was no evidence of effluent production or leakage during site visit. However the FERA highlighted potential risk arising from leaking of effluent from the silage pits.

50. The proposed management measures are:

- ***Impermeability of clay lined pits should be assessed;***
- ***Regular inspections for signs of leakage should be made. If leaking is identified, effluent should be attenuated immediately; and***
- ***Dry matter assessments recorded.***

51. Fertiliser - Specific fertiliser recommendations will be produced on an annual basis using a recommended system. Plant nutrient supply will be estimated from inorganic fertilisers as well as N fixation and animal return using a nutrient budgeting system. An annual application of approximately 40 kg N/ha is applied across the irrigated areas except the cropping areas where > 55 kg N/ha is applied to the ryecorn and no N fertiliser is applied to the specialist seed crop. The irrigated areas are maintained at an Olsen P of 25. The FERA highlighted potential fertiliser risks arising if soil Olsen P increase above 30.

52. The proposed mitigation measures is:

- ***Soil Olsen P levels to be maintained below 30.***

53. In addition, the soils will continue to be regularly tested and all streams and bores will have a 20 m and 50 m fertiliser layback respectively. The fertiliser will continue to be stored under cover and the filling area will remain where there are no drains and a direct discharge to ground in not possible

54. Chemicals - A contractor is currently used and will continue to be used to supply, handle, and apply chemicals on the farm. The FERA identified chemical risks associated with the current practice in that no back siphoning prevention measures are currently used when filling sprayers.

55. The proposed mitigation measure is:

- ***Back siphoning prevention measures will be implemented on the farm when filling sprayers from an un-isolated water supply.***

56. Cultivations - Direct drilling will be the predominant method of establishing crops and pastures. The FERA highlighted potential risks arising from soil compaction/consolidation in hydrologically connected areas and trafficking soil when wet, leading to runoff.

57. The proposed mitigation measure is:

- ***Compaction in hydrologically connected areas caused by machinery movement will need to be identified on an annual basis between late autumn and mid spring, excluding times when land is frozen. Compaction is identified both through visual inspection (of the soil surface and plant stress indicators) and through testing for compaction using a soil penetrometer and digging verification pits. Identified compaction should be removed at the earliest opportunity with an appropriate technique for the depth of compaction.***

58. The FERA highlighted current water risks associated with high rainfall conditions where overland flow from the neighbouring property flows onto Simons Hill Station, channelises and discharges to the Mary Burn. Under similar high rainfall conditions any of this received water not channelised forms standing pools. The FERA highlighted runoff risks associated with the possibility of runoff from the sheep yard reaching an ephemeral watercourse (flowing in the high rainfall conditions described above), and from there being sloping fields in hydrologically connected areas. The FERA highlighted tracks risk associated with the possibility of runoff from a track directly entering a watercourse.

59. The management or mitigation measures are:

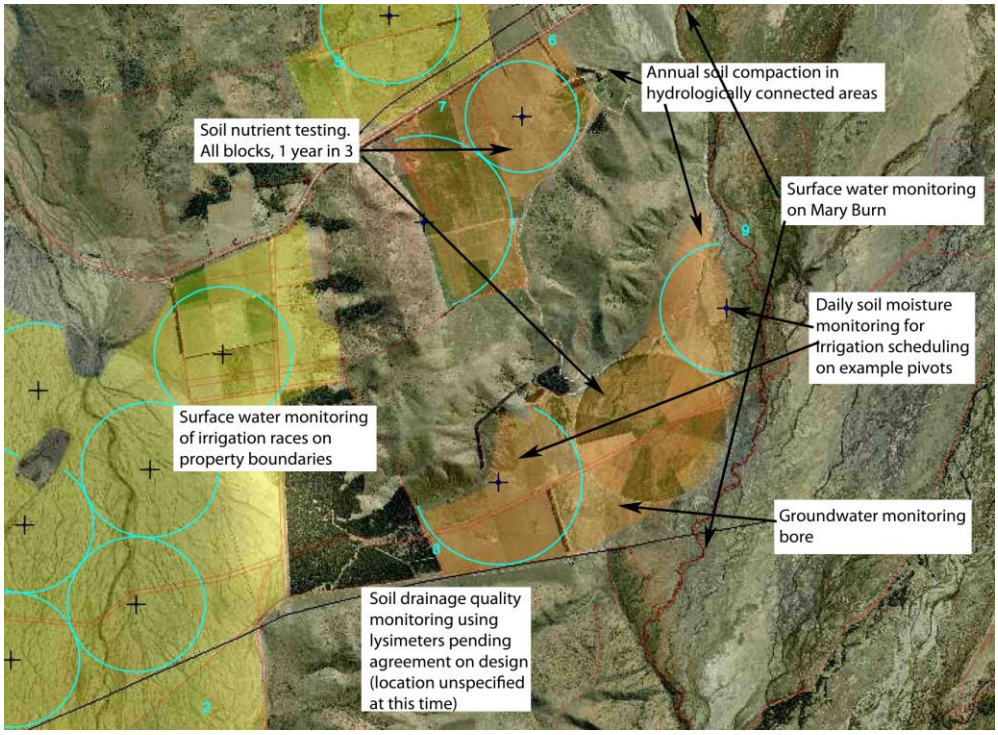
- ***Create single channel for received water to pass over property:***
- ***This channel to be avoided in final irrigation design;***
- ***Where conditions are such that the channel is flowing, stock will be removed from the paddock; and***
- ***A low bund will be built to stop any runoff from the track or the sheep yard entering the ephemeral watercourse.***

60. In addition, the densely vegetated area bordering the Mary Burn between the stream and House Hill should be maintained to continue in a buffering capacity for any surface runoff occurs from the eastern face of House Hill.

61. Biodiversity – The risks and required mitigations for protection of biodiversity on Simons Hill Station has been described in the evidence of Dr Ryder.

62. The environmental monitoring location plan for Simons Hill Station is shown below.

Figure 1: Environmental monitoring on Simons Hill Station



63. An annual auditing plan has been prepared for Simons Hill Station. The audit plan addresses both compliance with the WQS thresholds and the management plan options implemented to address identified site-specific environmental issues.

Table 4: Proposed contents of an annual audit for Simons Hill Station

Audit measures	Action in the case of non-compliance if applicable
Additional auditing that must be done externally	
Check riparian vegetation is present between House Hill and the Mary Burn along public access walkway, plus photographs	Significant disturbance in vegetation resulting in bare ground should be replanted as soon as practicable with similar species.
Check the storage of silage for visible signs of discharge and destination of silage liquor	Any discharge must be stopped immediately. Temporary barriers such as sawdust may be used to take up any discharges
Review of stock movement records to show winter feeding and stock movement, no cattle in unfenced paddock adjacent to Mary Burn, no cattle overwintering on top pivot east of House Hill and that stock are removed from paddock when it is receiving surface runoff from neighbouring property.	Where verification is not possible this should be rectified in the following year. Following that - non compliance
Bund to protect ephemeral watercourse from track and yard runoff	If bund is not in place or in tact, this should be rectified immediately and in place before next audit. Following that - non compliance.
Check fertiliser storage and filling area.	There should be no possibility of loss of fertiliser to drains or direct discharge to ground. Any drains should be covered, or the filling area moved to where no discharges will occur.
Annual audit of OVERSEER nutrient budget and report based on previous 3 years. Submission of compliance with thresholds.	Should the OVERSEER report show losses exceeding the threshold, further mitigations should be adopted to effect a reduction in nutrient loss to below thresholds.
Reconciliation of fertiliser and soil records with nutrient budget and fertiliser recommendations	Where reconciliation is not possible and an over application has occurred, this should be rectified in the following year. Following that - non compliance
Check DoC wetland and any new irrigation race fencing is in tact	Any failure in the integrity of the fencing must be repaired immediately or a temporary barrier placed around gap to prevent stock access.
Review measures recommended by irrigation audit have been implemented	Recommendations not already implemented should be done so prior to next audit.
Check channel receiving runoff water from neighbouring property is in place (plus photograph) and avoids pivot layout. (One off check)	If channel is not in place, this should be rectified for next audit. Following that – non compliance.
Review of back siphoning prevention measures	Immediate stop of use of unprotected water supply for filling chemical sprayers while permanent measures are put in place. If measures are not in place for following audit - non compliance.
Annual soil compaction survey on hydrologically connected areas, submission broad findings and remedials	Recommendations not already implemented should be done so prior to next audit. Following that - non compliance

Independent fertiliser spreader and irrigation testing and calibration 1 in 5 years	Spreaders and irrigators not performing should be recalibrated
Additional auditing that can be done either externally or internally	
Submission of pasture species on top pivot east of House Hill	No submission should be rectified for the next audit. Following that – non compliance
Submission of silage pit permeability test (One off test)	Where impermeablility is not established, a suitable grade concrete pad will have to be installed and clamp designs submitted
Submission and brief interpretation of soil, water quality, and machinery calibration tests	Where triggers have been exceeded, immediate contingency plans should have been effected and a root cause analysis conducted. The results of which should be presented here. Continual breach - non compliance
Submission of dated photographs showing maintained trash or green cover on cropped soils.	Evidence of soils left bare should be queried and rectified in the following year. Following that- non compliance
Submission of example irrigation schedules and reconciliation with soil moisture monitoring	The restriction of irrigation water to 600 mm/ha is an important driver to efficiency. Other sanctions are unlikely to be necessary to promote water use efficiency.
Annual fertiliser spreader and irrigation testing and calibration	Spreaders and irrigators not performing should be recalibrated
Submission of silage dry matter records	No submission should be rectified for the next audit. Following that – non compliance
Auditing that must be done internally	
Self certification for application of fertiliser according to code of practice	Any failures in observing the code of practice for applying fertiliser should be rectified and followed up in the next audit

Pukaki Flats South

64. A suite of scenarios have been modelled for Pukaki Flats South, of which two are presented here; dairy wintering off and intensive beef and sheep with dairy grazing.

65. The irrigated area of Pukaki Flats South, according to the WQS, lies in the Tekapo at Benmore surface water sub-catchment and in the Pukaki groundwater sub-catchment (GHD, 2009).

66. The local receiving environments for Pukaki Flats South that are not considered in the WQS is the wetland area on the southern the property boundary, the stretch of the Tekapo River beyond the southern boundary and the dry Pukaki River bed to the west of the property.

67. The wetland beyond the southern boundary of the property is characteristic of the Bendrose/Dobosn soil association indentified here with poorly drained Dobson soils in wet depressions (Webb, 1992). Land use activity on the lower terrace on the southern end of the property is modelled to contribute to the Tekapo River (GHD, 2009) and is likely to contribute to this wetland.

68. The Tekapo River is considered at its node point by the WQS, however the activities on this station, and in particular on the lower terraces may impact on the quality of the stretch of river bordering the property. The Pukaki river has flow only when spilling occurs from the Pukaki Dam, and remains dry otherwise.

Pukaki Flats South - WQS thresholds

69. A table showing the proposed whole farm losses from WQS, the WQS thresholds and the OVERSEER modelling outputs (modelling the proposed system with mitigations) is shown below. For this farm, the N mitigation requirements are the most stringent for the Pukaki groundwater and there are no restrictions for P. These WQS mitigation requirements set Pukaki Flats South's nutrient discharge allowance at 55,994 kg N per annum and 4,002 kg P per annum. However, due to a reallocation to the Rosehip properties, this threshold has been reduced to 47,312 kg N and 3,917 kg P. A full table showing the mitigation requirements for each receiving environment and the original predicted losses are given in each FEMP attached to this evidence.

70. After the groundwater threshold, the next receiving environment that would determine thresholds would be the Tekapo at Benmore. At this point an increase of 0.5 kg N and 0.4 kg P/ha would be permissible per ha of irrigated land (GHD, 2009). The remaining receiving environment, Northern Arm of Lake Benmore would permit an increase of approximately 50 kg N/ha and 0.4 kg P/ha of irrigated land according to the WQS.

Table 5: Total N and P losses modelled by OVERSEER for the proposed farming system on Pukaki Flats South WQS thresholds and original WQS proposed farm losses using a Developed setting.

		Proposed losses from WQS	WQS threshold kg/year	OVERSEER modelling outputs kg/year	
				Dairy off	S & B
Total	N	61,373	47,312	34,711	22,566

	Proposed losses from WQS	WQS threshold kg/year	OVERSEER modelling outputs kg/year	
leaching/ runoff				
Total P leaching/ runoff	4,002	3,917	1,127	606

71. On a per hectare basis over the entire farm, this gives an N loss of 9.6 kg N/ha for the dairy option and 6.2 kg N/ha for the sheep and beef option and a P loss of 0.3 kg/ha for the dairy option and 0.17 for the sheep and beef option. These losses are below the range quoted for typical dairy farms in New Zealand (30-50 kg N/ha) and near the bottom of the range for typical sheep and beef farms in New Zealand of 5-20 kg N/ha (OVERSEER v.5.4.3).

72. At a highly developed setting, the modelled N losses increase, and are given below for each of the scenarios. This setting allows for no immobilisation of N and is therefore conservative and represents the upper bound of N losses for the systems as they are described and modelled in OVERSEER 5.3.4. As these losses are still within the WQS threshold, no further mitigation would be required should the soils become highly developed.

Table 6 Total N and P losses modelled by OVERSEER for the proposed farming system on Pukaki Flats South WQS thresholds and original WQS proposed farm losses using a Highly Developed setting.

	Proposed losses from WQS	WQS threshold kg/year	OVERSEER modelling outputs kg/year	
			Dairy off	S & B
Total N leaching/ runoff	61,373	55,994	38,181	29,506

Pukaki Flats South - Proposed farming systems with mitigations

73. The first proposed farming system on Pukaki Flats South is an irrigated dairy farm with little winter grazing. It is designed to fit the pasture growth pattern by wintering all cows off as soon after drying off as possible. Replacements are also grazed off the property. Returning stock's feed requirements are met through silage. Excess pasture will be cut and ensiled between mid November and end of January (Ogle, 2009).

74. The second proposed farming system on Pukaki Flats South is an irrigated intensive beef and sheep farm with dairy grazing. This system makes use of surrounding high country runs, dairy farms and downland farms to source stock that are either grazed under contract or traded for finishing (Ogle, 2009). Stock winter feed requirements are buffered through feeding silage and fodder crops. Two cuts for silage will be made between early October and mid December to be fed out in winter (Ogle, 2009).

75. Soils - There is one main and three subsidiary soil series on Pukaki Flats South, Mackenzie soils, an association of Glenrock/Dalgety soil series, an association of Bendrose/Larbreck soil series, and an association of Bendrose/Dobson soil series. The FERA highlighted current soils risks associated with soils vulnerable to wind erosion on the property and the presence of some bare soils (associated with *Heiracium* infestations). These are risks will be greatly reduced with the onset of irrigation and good associated ground cover. Potential additional soils risks arise the use of conventional tillage to establish fodder crops (risk of wind erosion), and fodder crops grazed in situ over winter (scenario 2).

76. Unless stated, the risks and mitigations are common to all scenarios.

77. The proposed management or mitigation measures are:

- ***Use direct drilling as principal method for establishing fodder crops and pastures. If this is not possible, methods such as light irrigation may be employed post cultivation to reduce the likelihood of wind blow;***
- ***Regrass at the earliest opportunity after winter grazed kale crop (scenario 2).***

78. In addition, growing the fodder crops as a part of the pasture renewal process thus not mining soil organic matter levels in a few paddocks, should be practiced.

79. Stock - The proposed stock on the station are approximately 4,102 dairy cows with approximately 840 R2 heifers and 840 R1 heifers and heifer calves grazed

off (scenario 1) and between 3,323 and 6,646 cows (beef and dairy heifer) and between 5,585 and 27,664 sheep (lambs and hoggets) (scenario 2).

80. The FERA highlighted potential stock nutrient loss risks associated with stock being wintered outside on the property, and stock being fed on the lower terraces, and there being no provisions for fallen stock. The proposed management or mitigation measures are:

- ***Stock units are reduced over winter (scenario 1);***
- ***All stock will continue to be fenced out from Pukaki River bed boundary;***
- ***No stock will have access to irrigation race;***
- ***No stock will be fed out on the lower terraces of the property; and***
- ***All fallen stock will be removed from the property.***

81. Production - The irrigated area will be under a pasture mix including ryegrass and clover. Pasture production is expected to be between 11.8 and 15.5 t dry matter/ha on irrigated and fertilised land (AgResearch, 2009). An 85 % pasture utilisation rate has been assumed on irrigated land for dairy and 70% for sheep and beef (AgResearch, 2009). Cows are expected to produce 418 kg MS/cow (scenario 1) (Ogle, 2009).

82. Effluent production and handling - Effluent will be captured both during milking and from any associated loafing yards. If the loafing areas are uncovered, the volume of effluent will increase. The stocked areas will be regularly scraped into effluent storage facility.

83. The FERA highlighted potential effluent risks arising from there being no provision for clean and dirty water separation on the yard. The proposed management measure is:

- ***Clean water will be separated and collected and used, or diverted and discharged to ground (scenario 1).***

84. Effluent storage - The FERA highlighted potential effluent risks arising from no provision specified for the safe storage of effluent. The proposed management measures are:

- ***The effluent stored in a suitable lined facility (scenario 1);***
- ***The storage capacity of the facility should be sufficient for at least 4 months' of effluent and 6 months of solid fraction to allow deferred irrigation to be practiced (scenario 1); and***
- ***No effluent requiring to be spread in May, June, July, and August (scenario 1).***

85. Effluent application - The effluent will be applied using a calibrated spreader in accordance with the MGAPs. All applications will be recorded and accounted for when determining fertiliser requirements. An area of 337 ha has been set aside for effluent application.

86. The FERA highlighted potential effluent risks arising from no provision specified for the safe application of effluent and high additions of K from effluent application. The proposed management measures are:

- ***No effluent or manure will be applied within 20 m of a watercourse or wetland or within 50 of a bore or on lower terrace (scenario 1);***
- ***To test effluent regularly throughout the spreading season and record cumulative applications (scenario 1);***
- ***To apply effluent at appropriate times for plant uptake during active pasture growth (scenario 1);***
- ***Application depth should be determined by soil moisture deficit and a minimum soil moisture deficit should be maintained (scenario 1);***
- ***Soil K concentration and timing of effluent application should be monitored carefully on effluent blocks to avoid hypomagnesaemia (scenario 1);***
- ***No spread areas should be clearly displayed in farm office and in tractor cab when spreading solids (scenario 1);***
- ***Monitor soil K status on effluent areas (scenario 1); and,***
- ***Low rate of effluent application (scenario 1).***

87. Silage storage - The FERA highlighted potential effluent risks arising from silage liquor[5] not being collected and spread to land and that direct discharges may be occur from the silage pits. The proposed management measures are:

- ***Silage is made and stored on a concrete pad and drains to an effluent collection facility;***
- ***The silage liquor will be recycled to land along with the effluent; and,***
- ***Due to the unknown nutrient concentrations in the liquor, the combined effluent will be regularly tested during spreading and the cumulative applications recorded (scenario 1).***

88. Fertiliser - Specific fertiliser recommendations will be produced on an annual basis using a recommended system. Plant nutrient supply will be estimated from inorganic and organic fertilisers as well as N fixation and animal return

[5] All facilities containing silage and silage liquor must be of the appropriate specification as the liquor is highly corrosive.

using a nutrient budgeting system. An annual application of approximately 164 and 40 kg N/ha is applied across the irrigated areas in scenarios 1 and 2 respectively, The irrigated areas are maintained at an Olsen P of 30 in dairy systems and 25 in sheep and beef systems.

89. The FERA highlighted potential fertiliser risks arising from larger than 50 kg/ha applications of N fertiliser, soil Olsen P increasing above 30 and from no suitable storage and filling area being identified. The proposed mitigation measures are:

- ***Soil Olsen P levels to be maintained at or below 30;***
- ***Split applications of N fertiliser to <50 kg N/ha;***
- ***Fertiliser to be stored in a covered area;***
- ***The identified filling areas will be at least 50 m from a watercourse, spring or bore and will have no drains that discharge to clean water or that can discharge direct to ground; and,***
- ***If liquid fertilisers are used, fertiliser should be stored in a bunded tank and protected from vehicle movements.***

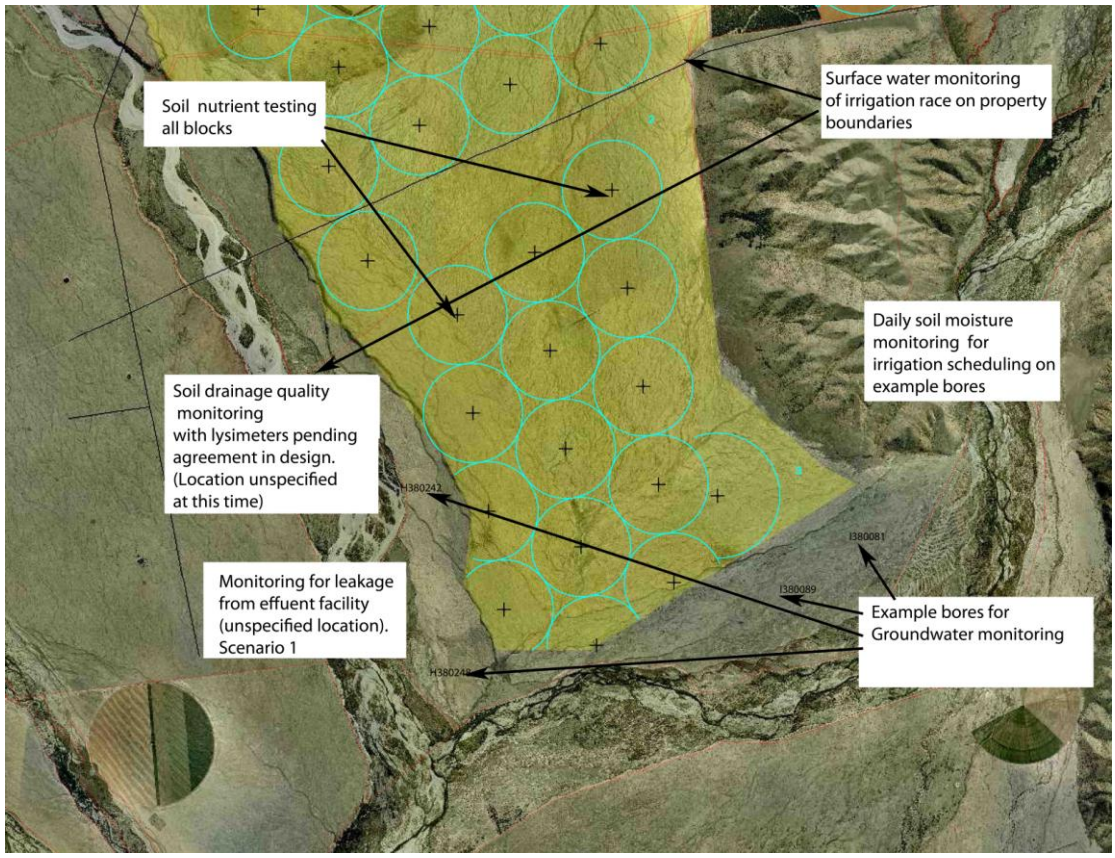
90. In addition, the soils will be regularly tested.

91. Chemicals - The FERA highlighted that no chemical management strategy was in place. To satisfy the issues raised in the FERA the proposed management measures are:

- ***A contractor or approved handler to be used to supply, handle, and apply chemicals on the farm;***
- ***The services of a professional crop adviser or other suitably qualified person to be used to advise on pesticide options, doses and tank mixes; and,***
- ***Back siphoning prevention measures will be implemented on the farm when filling sprayers from an un-isolated water supply***

92. The environmental monitoring location plan for Pukaki Flats South is shown below.

Figure 2: Environmental monitoring on Pukaki Flats South



93. An annual auditing plan has been prepared for Pukaki Flats South. The audit plan addresses both compliance with the WQS thresholds and the management plan options to address identified site-specific environmental issues.

Table 7: Proposed contents of an annual audit for Pukaki Flats South for scenarios 1 and 2

Audit measures	Action in the case of non-compliance if applicable	Applicable scenarios
Additional auditing that must be done externally		
Check the clean and dirty water separation methods in and around the parlour and yards, plus photographs	If any contamination of clean water is found all water should be directed to effluent store until problem is found and effective separation is verified.	1
Check for evidence of direct discharges from the parlour and yard area	Any direct discharge must be stopped immediately. Temporary barriers such as straw bales may be used to take up any discharges until permanent structures are in place.	1
Check the storage of silage for visible signs of discharge and destination of silage liquor	All liquid should drain into effluent storage. Any discharge must be stopped immediately. Temporary barriers such as straw bales may be used to take up any discharges until permanent structures are in place.	1,2

Check fertiliser storage and filling area.	There should be no possibility of loss of fertiliser to drains or direct discharge to ground. Any drains should be covered, or the filling area moved to where no discharges will occur.	1,2
Check integrity of fencing of Tekapo and Pukaki River beds	Any failure in fencing should be sealed immediately with temporary barriers if stock are present, until a permanent repair is completed.	1,2
Review of stock movement records to show winter feeding and stock movement, and no feeding out on lower terraces.	Where verification is not possible this should be rectified in the following year. Following that - non compliance.	1,2
Annual audit of OVERSEER nutrient budget and report based on previous 3 years. Submission of compliance with thresholds.	Should the OVERSEER report show losses exceeding the threshold, further mitigations should be adopted to effect a reduction in nutrient loss to below thresholds.	1,2
Reconciliation of fertiliser, effluent and soil records with nutrient budget and fertiliser recommendations	Where reconciliation is not possible and an over application has occurred, this should be rectified in the following year. Following that - non compliance	1,2
Review crop records to verify undersown or bi-cropped second fodder crop.	Where verification is not possible this should be rectified in the following year. Following that - non compliance	1
Review of fertiliser records to verify split applications	Where verification is not possible this should be rectified in the following year. Following that - non compliance	1
Review of cumulative effluent applications to verify no winter application and application depth	Where verification is not possible this should be rectified in the following year. Following that - non compliance	1
Review measures recommended by irrigation audit have been implemented	Recommendations not already implemented should be done so prior to next audit.	1,2
Review of back siphoning prevention measures	Immediate stop of use of unprotected water supply for filling chemical sprayers while permanent measures are put in place. If measures are not in place for following audit - non compliance.	1,2
Review of fallen stock policy - use of a contractor to removed fallen stock	Concerns or absence of policy should be rectified for next audit. Following that - non compliance.	1,2
Review of chemical management policy - use of contractor, approved handler status, use of a crop adviser	Concerns or absence of policy should be rectified for next audit. Following that - non compliance.	1,2
Review of no spread zones for fertiliser and or manure and effluent	Map should be displayed for next audit. Following that - non compliance.	1,2
Review methods employed to reduce wind blow on cultivated land	Concerns or absence of methods should be rectified for next audit. Following that - non compliance.	1,2

Review of crop records to verify rotation of fodder crops	Concerns or absence of over rotation should be rectified for next audit. Following that - non compliance.	1,2
Independent fertiliser spreader and irrigation testing and calibration 1 in 5 years	Spreaders and irrigators not performing should be recalibrated.	1,2
Additional auditing that can be done either externally or internally		
Submission of silage clamp and effluent storage design plans	Once approved, the plans need only to be submitted once.	1,2
Submission and brief interpretation of soil, and or effluent, water quality, and machinery calibration tests	Where triggers have been exceeded, immediate contingency plans should have been implemented and a root cause analysis conducted. The results of which should be presented here. Continual breach - non compliance.	1,2
Submission of example irrigation schedules and reconciliation with soil moisture monitoring	The restriction of irrigation water to 600 mm/ha is an important driver to efficiency. Other sanctions are unlikely to be necessary to promote water use efficiency.	1,2
Annual fertiliser spreader and irrigation testing and calibration	Spreaders and irrigators not performing should be recalibrated.	1,2
Auditing that must be done internally		
Self certification for application of fertiliser according to code of practice	Any failures in observing the code of practice for applying fertiliser should be rectified and followed up in the next audit.	1,2

Pukaki Flats North

94. A suite of scenarios have been modelled for Pukaki Flats North, of which two are presented here; dairy wintering off, and intensive beef and sheep with dairy grazing.

95. The irrigated area of Pukaki Flats North, according to the WQS, lies in the Tekapo at Benmore surface water sub-catchment and in the Pukaki groundwater sub-catchment (GHD, 2009).

96. There are no on farm local receiving environment for Pukaki Flats North however, off farm, the dry bed of the Pukaki River occasionally has flow when spilling from the lake occurs. The northern part of the property does approach the shores of Lake Pukaki, but no change in land use is expected here and the lake is effectively upstream of the property and therefore it has not been determined as a receiving environment.

97. The Pukaki River is a mainly dry river bed and flows only occasionally when water is released over the dam, and during spilling, the flows released can be very high (GHD, 2009a) .

Pukaki Flats North - WQS thresholds

98. A table showing the proposed whole farm losses from WQS, the WQS thresholds and the OVERSEER modelling outputs (modelling the proposed system with mitigations) is shown below. For this farm, the N mitigation requirements are the most stringent for the Pukaki groundwater and there are no restrictions for P. These WQS mitigation requirements set Pukaki Flats South's nutrient discharge allowance at 94,490 kg N per annum and 7,162 kg P per annum. However, due to a reallocation to the Rosehip properties, this threshold has been reduced to 85,808 kg N and 7,077 kg P. A full table showing the mitigation requirements for each receiving environment and the original predicted losses are given in each FEMP attached to this evidence.

Table 8: Total N and P losses modelled by OVERSEER for the proposed farming system on Pukaki Flats North WQS thresholds and original WQS proposed farm losses using a Developed setting.

	Proposed losses from WQS	**WQS threshold kg/year**	**OVERSEER modelling outputs kg/year**	
			Dairy off	S & B
Total N leaching/ runoff	101,580	85,808	50,660	35,958
Total P leaching/ runoff	7,162	7,077	1,492	675

99. On a per hectare basis over the entire farm, this gives an N loss of 9.4 kg/ha for the dairy option and 6.7 for the sheep and beef option and a P loss of 0.3 kg/ha for the dairy option and 0.1 kg P/ha the sheep and beef option. These losses are below the range quoted for typical dairy farms in New Zealand (30-50 kg N/ha) and near the bottom of the range for typical sheep and beef farms in New Zealand of 5-20 kg N/ha (OVERSEER v.5.4.3).

100. At a highly developed setting, the modelled N losses increase and are given below for each scenario. This setting allows for no immobilisation of N and is therefore conservative and represents the upper bound of N losses for the systems as they are described and modelled in OVERSEER 5.3.4. As these losses are still within the WQS threshold, no further mitigation would be required should the soils become highly developed.

Table 9: Total N and P losses modelled by OVERSEER for the proposed farming system on Pukaki Flats North WQS thresholds and original WQS proposed farm losses using a Highly Developed setting.

	Proposed losses from WQS	**WQS threshold kg/year**	**OVERSEER modelling outputs kg/year**	
			Dairy off	S & B
Total N leaching/ runoff	101,580	94,490	56,541	43,799

Pukaki Flats North - Proposed farming systems with mitigations

101. The three proposed farming systems for Pukaki Flats North are the same as those put forward on Pukaki Flats South, described in paragraphs 70-72 above.

102. Soils - There are three main and two subsidiary soil series on Pukaki Flats North; Mackenzie soils, an association of Pukaki/Houlbrook soil series, an association of Tekapo/MaryBurn soil series and more minor incursions of an association of Bendrose/Larbreck soil series and an association of Grampian/Simons/Glenrock. The irrigation command area has been split along the Mackenzie and Pukaki/Holbrook boundary demarcating deeper soils to the north and shallower Mackenzie soils to the south.

103. The FERA highlighted current soils risks are associated with soils vulnerable to wind erosion on the property and the presence of some bare soils (associated with *Heiracium* infestations). These risks will be greatly reduced with the onset of irrigation and good associated ground cover. Potential additional soil risks arise from the use of conventional tillage to establish fodder crops (risk of wind erosion), and fodder crops grazed in situ over winter (scenario 2).

104. The proposed management or mitigation measures are:

- ***Use direct drilling as principal method for establishing fodder crops and pastures. If this is not possible, methods such as light irrigation may be employed post cultivation to reduce the likelihood of wind blow; and***
- ***Regrass at the earliest opportunity after winter grazed kale crop (scenario 2).***

105. In addition, growing the fodder crops as a part of the pasture renewal process thus not mining soil organic matter levels in a few paddocks, should be practiced.

106. The FERA highlighted area specific soil risks for irrigated areas on Grampians/Simons/Glenrock association as this soil is vulnerable to capping and may exhibit perching of water in the top 50 cm above a fragipan.

- ***These soils should not be trafficked when wet.***
- ***These soils should not be left bare over winter.***

107. The FERA highlighted area specific soil risks for irrigated areas on Tekapo/Mary association. This soil association has firm till in some areas within 50 cm of the surface and are therefore vulnerable to subsurface compaction.

- ***These soils should not be trafficked when wet.***

108. Stock - The proposed stock on the station are approximately 6,207 dairy cows with approximately 1,350 R2 heifers and 1,350 R1 heifers and heifer calves grazed off (scenario 1) and between 4,593 and 9,186 cows (beef and dairy heifer) and between 7,955 and 38,250 sheep (lambs and hoggets) (scenario 2).

109. The FERA highlighted potential stock nutrient loss risks associated with stock being wintered outside on the property, and stock being fed on the lower terraces, and there being no provisions for fallen stock. The proposed management or mitigation measures are:

- ***Reduced stock units over winter (scenario 1);***
- ***All stock will be fenced out 100 m from Pukaki River bed boundary;***
- ***No stock will have access to irrigation race;***
- ***No stock will be fed out on the lower terraces of the property; and***
- ***All fallen stock will be removed from the property.***

110. Production - The irrigated area will be under a pasture mix including ryegrass and clover. Pasture production is expected to be between 13.7 and 15.5 t dry matter/ha on irrigated and fertilised land. An 85 % pasture utilisation rate has

been assumed on irrigated land for dairy and 70 % for sheep and beef (AgResearch, 2009). Cows are expected to produce between 409 and 417 kg MS/cow (scenario 1) (Ogle, 2009).

111. Effluent production and handling - Effluent will be captured both on the feed pad, during milking and from any associated loafing yards. If the loafing and feed pad areas are uncovered, the volume of effluent will increase. The stocked areas will be regularly scraped into effluent storage facility.

112. The FERA highlighted potential effluent risks arising from there being no provision for clean and dirty water separation on the yard. The proposed management measure is:

- ***Clean water will be separated and collected and used, or diverted and discharged to ground (scenario 1).***

113. Effluent storage - The FERA highlighted potential effluent risks arising from no provision specified for the safe storage of effluent. The proposed management measures are:

- ***The effluent stored in a suitable lined facility (scenario 1);***
- ***The storage capacity of the facility should be sufficient for at least 4 months' of effluent to allow deferred irrigation to be practiced (scenario 1); and***
- ***No effluent requiring to be spread in May, June, July, and August (scenario 1).***

114. Effluent application - The effluent will be applied using a calibrated spreader in accordance with the MGAPs. All applications will be recorded and accounted for when determining fertiliser requirements. Areas of 440 ha (scenario 1) have been set aside for effluent application.

115. The FERA highlighted potential effluent risks arising from no provision specified for the safe application of effluent. The proposed management measures are:

- ***No effluent or manure will be applied within 20 m of a watercourse or wetland or within 50 of a bore or on lower terrace (scenario 1);***
- ***To test effluent regularly throughout the spreading season and record cumulative applications (scenario 1);***
- ***To apply effluent at appropriate times for plant uptake during active pasture growth (scenario 1);***
- ***Application depth should be determined by soil moisture deficit and a minimum soil moisture deficit should be maintained as determined by the lowest PAW under each pivot (scenario 1);***

- ***Soil K concentration and timing of effluent application should be monitored carefully on effluent blocks to avoid hypomagnesaemia (scenario 1);***
- ***No spread areas should be clearly displayed in farm office and in tractor cab when spreading solids (scenario 1); and,***
- ***Low rate of effluent application (scenario 1).***

116. Silage storage - The FERA highlighted potential effluent risks arising from silage liquor[6] not being collected and spread to land and that direct discharges may be occur from the silage pits. The proposed management measures are:

- ***Silage is made and stored on a concrete pad and drains to an effluent collection facility;***
- ***The silage liquor will be recycled to land; and,***
- ***Due to the unknown nutrient concentrations in the liquor, the combined effluent will be regularly tested during spreading and the cumulative applications recorded (scenario 1).***

117. Fertiliser - Specific fertiliser recommendations will be produced on an annual basis using a recommended system. Plant nutrient supply will be estimated from inorganic and organic fertilisers as well as N fixation and animal return using a nutrient budgeting system. An annual application of approximately 164 and 40 kg N/ha is applied across the irrigated areas in scenarios 1 and 2 respectively, The irrigated areas are maintained at an Olsen P of 30 in dairy systems and 25 in sheep and beef systems.

118. The FERA highlighted potential fertiliser risks arising from larger than 50 kg/ha applications of N fertiliser, soil Olsen P increasing above 30 and from no suitable storage and filling area being identified. The proposed mitigation measures are:

- ***Soil Olsen P levels to be maintained at or below 30;***
- ***Split applications of N fertiliser to <50 kg N/ha;***
- ***Fertiliser to be stored in a covered area;***
- ***The identified filling areas will be at least 50 m from a watercourse, spring or bore and will have no drains that discharge to clean water or that can discharge direct to ground; and,***
- ***If liquid fertilisers are used, fertiliser should be stored in a bunded tank and protected from vehicle movements.***

119. In addition, the soils will be regularly tested.

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[6] All facilities containing silage and silage liquor must be of the appropriate specification as the liquor is highly corrosive.

120. The FERA highlighted area specific fertiliser risks for irrigated areas on Tekapo/Mary association. This soil association has diverse drainage and profile characteristics with some deep soils interspersed with shallow stony soils in NW wind exposed areas, making these areas vulnerable to under or over fertilisation.

- ***Differential fertiliser application is recommended, through GPS application to avoid over application of fertiliser on Mary soils in particular (scenario 1).***

121. The FERA highlighted area specific fertiliser risks for irrigated areas on Pukaki/Holbrook association. This soil association has diverse drainage and profile characteristics with moderately deep soils interspersed with shallow stony soils in deflation hollows, making these areas vulnerable to under or over fertilisation.

- ***Differential fertiliser application is recommended, through GPS application to avoid over application of fertiliser on Holbrook soils in particular (scenario 1).***

122. Water - The FERA highlighted area specific irrigation risks for irrigated areas on Pukaki/Holbrook association. This soil association has diverse drainage and profile characteristics with moderately deep soils interspersed with shallow stony soils in deflation hollows, making these areas vulnerable to under or over irrigation.

- ***Differential irrigation is recommended for example through solenoid valve technology to avoid over irrigation on Holbrook soils in particular.***

123. The FERA highlighted area specific soil risks for irrigated areas on Tekapo/Mary association. This soil association has diverse drainage and profile characteristics with some deep soils interspersed with shallow stony soils in NW wind exposed areas, making these areas vulnerable to under or over irrigation.

- ***Differential irrigation is recommended for example through solenoid valve technology application to avoid over irrigation on Mary soils in particular.***

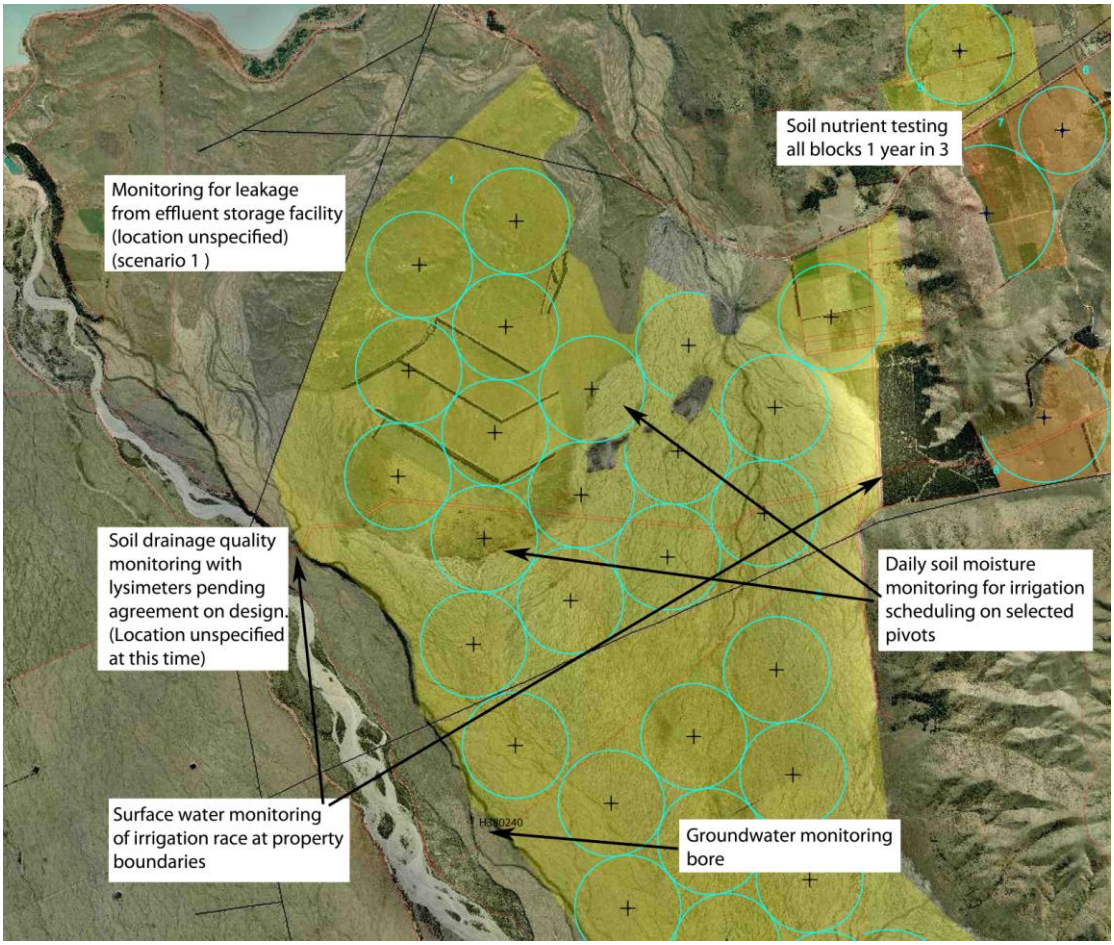
124. Chemicals - The FERA highlighted that no chemical management strategy was in place. To satisfy the issues raised in the FERA the proposed management measures are:

- ***A contractor or approved handler to be used to supply, handle, and apply chemicals on the farm;***
- ***The services of a professional crop adviser or other suitably qualified person to be used to advise on pesticide options, doses and tank mixes; and,***

- ***Back siphoning prevention measures will be implemented on the farm when filling sprayers from an un-isolated water supply***

125. The environmental monitoring plan for Pukaki Flats North is shown below.

Figure 3: Environmental monitoring on Pukaki Flats North



126. An annual auditing plan has been prepared for Pukaki Flats North. The audit plan addresses both compliance with the WQS thresholds and the management plan options to address identified site-specific environmental issues.

Table 10: Proposed contents of an annual audit for Pukaki Flats North for scenarios 1, 2 and 3

Audit measures	Action in the case of non-compliance if applicable	Applicable scenarios
Additional auditing that must be done externally		
Check the clean and dirty water separation methods in and around the parlour and yards, plus photographs	If any contamination of clean water is found all water should be directed to effluent store until problem is found and effective separation is verified	1

Check for evidence of direct discharges from the parlour and yard area	Any direct discharge must be stopped immediately. Temporary barriers such as straw bales may be used to take up any discharges until permanent structures are in place	1
Check the storage of silage for visible signs of discharge and destination of silage liquor	All liquid should drain into effluent storage. Any discharge must be stopped immediately. Temporary barriers such as straw bales may be used to take up any discharges until permanent structures are in place	1,2
Check fertiliser storage and filling area.	There should be no possibility of loss of fertiliser to drains or direct discharge to ground. Any drains should be covered, or the filling area moved to where no discharges will occur.	1,2
Review of stock movement records to show winter feeding and stock movement, and no feeding out on lower terraces.	Where verification is not possible, this should be rectified for the next audit. Followin this – non compliance.	1,2
Annual audit of OVERSEER nutrient budget and report based on previous 3 years. Submission of compliance with thresholds.	Should the OVERSEER report show losses exceeding the threshold, further mitigations should be adopted to effect a reduction in nutrient loss to below thresholds.	1,2
Reconciliation of fertiliser, effluent and soil records with nutrient budget and fertiliser recommendations	Where reconciliation is not possible and an over application has occurred, this should be rectified in the following year. Following that - non compliance	1,2
Review crop records to verify undersown or bi-cropped second fodder crop.	Where verification is not possible this should be rectified in the following year. Following that - non compliance	1
Review of fertiliser records to verify split applications	Where verification is not possible this should be rectified in the following year. Following that - non compliance	1
Review of cumulative effluent applications to verify no winter application and application depth	Where verification is not possible this should be rectified in the following year. Following that - non compliance	1
Review measures recommended by irrigation audit have been implemented	Recommendations not already implemented should be done so prior to next audit.	1,2
Review of back siphoning prevention measures	Immediate stop of use of unprotected water supply for filling chemical sprayers while permanent measures are put in place. If measures are not in place for following audit - non compliance.	1,2
Review of fallen stock policy - use of a contractor to removed fallen stock	Concerns or absence of policy should be rectified for next audit. Following that - non compliance	1,2
Review of chemical management policy - use of contractor, approved handler status, use of a crop adviser	Concerns or absence of policy should be rectified for next audit. Following that - non compliance	1,2

Review of no spread zones for fertiliser and or manure and effluent	Map should be displayed for next audit. Following that - non compliance	1,2
Review methods employed to reduce wind blow on cultivated land	Concerns or absence of methods should be rectified for next audit. Following that - non compliance	1,2
Check integrity of fencing of Tekapo and Pukaki River beds	Any failure in fencing should be sealed immediately with temporary barriers if stock are present, until a permanent repair is completed.	1,2
Review of crop records to verify rotation of fodder crops	Concerns or absence of over rotation should be rectified for next audit. Following that - non compliance	1,2
Review of crop records to verify early regrassing after kale crop	Concerns or absence of over rotation should be rectified for next audit. Following that - non compliance	2
Review measures recommended to remove compaction across Gr/Sm/Gk association and Tk/My association soil	Recommendations not already implemented should be done so prior to next audit. Following that - non compliance	1,2
Independent fertiliser spreader and irrigation testing and calibration 1 in 5 years	Spreaders and irrigators not performing should be recalibrated	1,2
Additional auditing that can be done either externally or internally		
Submission of silage clamp and effluent storage design plans	Once approved, the plans need only to be submitted once	1,2
Submission and brief interpretation of soil, and or effluent, water quality, and machinery calibration tests	Where triggers have been exceeded, immediate contingency plans should have been implemented and a root cause analysis conducted. The results of which should be presented here. Continual breach - non compliance	1,2
Submission of example irrigation schedules and reconciliation with soil moisture monitoring	The restriction of irrigation water to 600 mm/ha is an important driver to efficiency. Other sanctions are unlikely to be necessary to promote water use efficiency.	1,2
Submission of GPS fertiliser application map for pivots on Pk/Hk association and Tk/My association soils	Map should be produced for next audit. Following that - non compliance	1
Submission of precision irrigation application map for pivots on Pk/Hk association and Tk/My association soils	Map should be produced for next audit. Following that - non compliance	1,2
Annual fertiliser spreader and irrigation testing and calibration	Spreaders and irrigators not performing should be recalibrated	1,2
Auditing that must be done internally		
Self certification for application of fertiliser according to code of practice	Any failures in observing the code of practice for applying fertiliser should be rectified and followed up in the next audit	1,2

Mary Range Farming

127. The proposed irrigation area of Mary Range Station lies in the Mary Burn surface water sub-catchment and in the Tekapo groundwater sub-catchment identified in the WQS (GHD, 2009).

128. There are no on farm local receiving environments for Mary Range Station, however, off farm, the local receiving environments are the neighbouring station, Simons Hill and the Mary Burn at the base of House Hill. Received water from the Mary Range, surface runoff and border dyke outwash leaves the property and discharges onto the neighbouring station through multiple channels, some of which converge and discharge into the Mary Burn.

129. The Mary Burn water quality and ecology in the downstream reach are considered in the WQS, however runoff from this property can discharge into the Mary Burn via the neighbouring property Simons Hill Station. The stream ecological value is described by Dr Ryder in his evidence.

Mary Range Station - WQS thresholds

130. A table showing the proposed whole farm losses from WQS, the WQS thresholds and the OVERSEER modelling outputs (modelling the proposed system with mitigations) are shown below. For this farm, the N mitigation requirements are the most stringent for the Tekapo River and the P mitigations are most stringent for the Mary Burn. These WQS mitigation requirements set Mary Range Station's nutrient discharge allowance at 17,794 kg N per annum and 1,013 kg P per annum. A full table showing the mitigaiton requirements for each receiving environment and the original predicted losses are given in each FEMP attached to this evidence.

Table 11: Total N and P losses modelled by OVERSEER for the proposed farming system on Mary Range Station WQS thresholds and original WQS proposed farm losses using a Developed setting.

	Proposed losses from WQS	**WQS threshold kg/year**	**OVERSEER modelling outputs kg/year**
Total N leaching/ runoff	18,024	17,794	4,949
Total P leaching/ runoff	1,271	1,013	187

131. On a per hectare basis over the entire farm, this gives an N loss of approximately 5.2 kg/ha and a P loss of approximately 0.2 kg/ha. These losses are at the bottom of range quoted for typical sheep and beef farms in New Zealand of 5-20 kg N/ha (OVERSEER v.5.4.3).

132. At a highly developed setting, the modelled N losses increase and are given below. This setting allows for no immobilisation of N and is therefore conservative and represents the upper bound of N losses for the systems as they are described and modelled in OVERSEER 5.3.4. As these losses are still within the WQS threshold, no further mitigation would be required should the soils become highly developed.

Table 12: Total N and P losses modelled by OVERSEER for the proposed farming system on Mary Range Station WQS thresholds and original WQS proposed farm losses using a Highly Developed setting.

	Proposed losses from WQS	**WQS threshold kg/year**	**OVERSEER modelling outputs kg/year**
Total N leaching/ runoff	18,024	17,794	5,810

Mary Range Station - Proposed farm system with mitigations

133. The proposed farming system on Mary Range Station is an irrigated intensive beef and sheep farm with dairy grazing. This system makes use of surrounding high country runs, dairy farms and downland farms to source stock that are either grazed under contract or traded for finishing (Ogle, 2009). Stock are wintered outside with the combination of grazing and a feed pad and winter feed requirements are buffered through feeding silage and fodder crops. Two cuts for silage will be made between early October and mid December to be fed out in winter (Ogle, 2009).

134. Soils - The one main soil series on Mary Range Station (excluding the hill country) is an association of Grampian/Simons/Glenrock soils. The FERA highlighted current soils risks are associated with capped and consolidated soils. Potential additional soils risks arising the use of conventional tillage to establish fodder crops (risk of wind erosion), fodder crops grazed in situ late in autumn before being left bare over winter, overwintering stock and trafficking when wet.

135. The proposed management or mitigation measures are:

- ***Use direct drilling as principal method for establishing fodder crops and pastures. If this is not possible, methods such as light irrigation may be employed post cultivation to reduce the likelihood of wind blow;***
- ***Regrass at the earliest opportunity after winter grazed kale crop; and,***
- ***No trafficking of the soil when wet and as this is not always possible, the annual monitoring and identification of soil compaction in hydrologically connected areas and documented remedial actions taken. Compaction in hydrologically connected areas will need to be identified on an annual basis between late autumn and mid spring, excluding times when land is frozen. Compaction is identified both through visual inspection (of the soil surface and plant stress indicators) and through testing for compaction using a soil penetrometer and digging verification pits. Identified compaction should be removed at the earliest opportunity with an appropriate technique for the depth of compaction***

136. In addition, growing the fodder crops as a part of the pasture renewal process thus not mining soil organic matter levels in a few paddocks, should be practiced.

137. Stock - The proposed stock on the station are between 530 and 1060 cows (beef and dairy heifer) and between 721 and 4500 sheep (lambs and hoggets) (Ogle, 2009). The FERA highlighted potential stock nutrient loss risks associated with stock being wintered outside on the property, and there being no provisions for fallen stock. The proposed management or mitigation measures are:

- ***Frequent movement of stock over winter period and reduced stock units over winter;***
- ***No stock will have access to any open channel irrigation races; and,***
- ***All fallen stock will be removed from the property.***

138. Production - The irrigated area will be under a pasture mix including ryegrass and clover. Pasture production is expected to be approximately 13.7 t dry matter/ha on irrigated and fertilised land. A 70 % pasture utilisation rate has been assumed on irrigated land. The annual farm production will be in the form of the 150 heifer grazers, 2,500 merino hoggets finished, 380 bulls finished and 4,500 cross bred lambs finished (Ogle, 2009).

139. Effluent/Silage - Stock will not be housed under the proposed system and therefore manure and effluent will not be collected. The FERA highlighted potential effluent risks arising from silage liquor[7] not being collected and spread to land and that direct discharges may be occur from the silage pits.

140. The proposed management measures are:

- ***Silage is made and stored on a suitable grade concrete pad and drains to an effluent collection facility; and,***
- ***The silage liquor will be recycled to land.***

141. Fertiliser - Specific fertiliser recommendations will be produced on an annual basis using a recommended system. Plant nutrient supply will be estimated from inorganic fertilisers as well as N fixation and animal return using a nutrient budgeting system. An annual application of approximately 33 kg N/ha is applied across the irrigated areas except the cropping areas where 33-64 kg N/ha is applied to the turnip, swede and kale crop. The irrigated areas are maintained at an Olsen P of 25. The FERA highlighted potential fertiliser risks arising if soil Olsen P increase above 30 and from no suitable storage and filling area being identified. In addition, the soils will be regularly tested.

142. The proposed mitigation measures are:

- ***Soil Olsen P levels to be maintained at or below 30.***
- ***Fertiliser to be stored in a covered area;***
- ***The identified filling areas will be at least 50 m from a watercourse, spring or bore and will have no drains that discharge to clean water or that can discharge direct to ground; and,***
- ***If liquid fertilisers are used, fertiliser should be stored in a bunded tank and protected from vehicle movements.***

143. Chemicals - FERA highlighted that no chemical management strategy was in place. To satisfy the issues raised in the FERA the proposed management measures are:.

- ***A contractor or approved handler to be used to supply, handle, and apply chemicals on the farm;***
- ***The services of a professional crop adviser or other suitably qualified person to be used to advise on pesticide options, doses and tank mixes; and,***

[7] All facilities containing silage and silage liquor must be of the appropriate specification as the liquor is highly corrosive.

- ***Back siphoning prevention measures will be implemented on the farm when filling sprayers from an un-isolated water supply.***

144. Water - The FERA highlighted water and runoff risks arising from surface runoff (including border dyke losses) from the property discharging on the a neighbouring property and ultimately into the Mary Burn, sloping fields adjacent to waterways vulnerable to runoff, no reticulated water supply and stock tracks running through waterways.

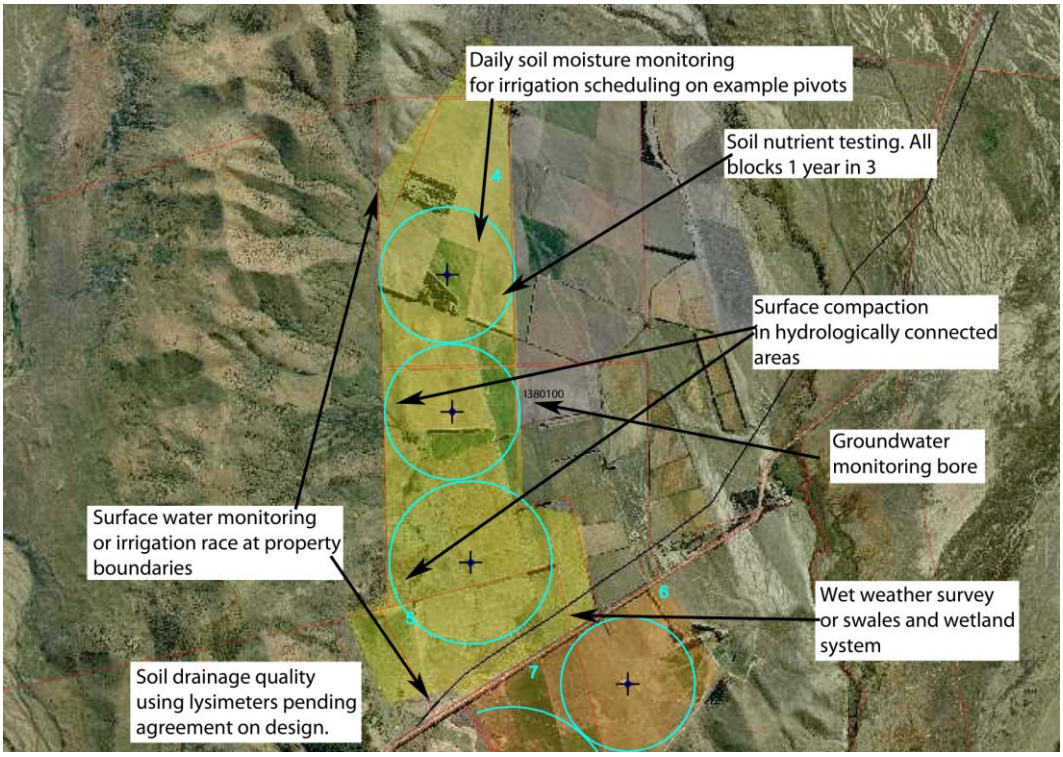
145. The management or mitigation measures are:

- ***Create a 2 wetland and swale system for attenuating runoff with single outlet point through to neighbouring property. The first wetland is an expansion and protection of the area already identified by willow growth. Outlet from this area will be through an existing open channel and discharged into the swale. The swale (broad, shallow, grassed channel) should be installed running parallel with the state highway, this will pick up any runoff from the property and discharge into created depression/wetland placed at the lowest point of the property. Any outlet from this wetland will cross the road through the existing culvert and discharge on to the neighbouring station through a single channel. The existing race that captures and transports runoff from the west and north of the property should discharge into the swale and the western end;***
- ***A wet weather survey should be conducted when possible to review the swale/wetland system;***
- ***All water for stock should be provided by a reticulated water supply; and,***
- ***Stock tracks running through waterways should be culverted and direct runoff prevented.***

146. Biodiversity – The risks and required mitigations for protection of biodiversity on Simons Hill Station has been described in the evidence of Dr Ryder.

147. The environmental monitoring plan for Mary Range Station is shown below.

Figure 4: Environmental monitoring on Mary Range Station



148. An annual auditing plan has been prepared for Mary Range Station. The audit plan addresses both compliance with the WQS thresholds and the management plan options implemented to address identified site-specific environmental issues.

Table 13: Proposed contents of an annual audit for Mary Range Station

Audit measures	Action in the case of non-compliance if applicable
Additional auditing that must be done externally	
Check the storage of silage for visible signs of discharge and destination of silage liquor	All liquid should drain into effluent storage. Any discharge must be stopped immediately. Temporary barriers such as straw bales may be used to take up any discharges until permanent structures are in place
Check fertiliser storage and filling area.	There should be no possibility of loss of fertiliser to drains or direct discharge to ground. Any drains should be covered, or the filling area moved to where no discharges will occur.
Review of stock movement records to show winter feeding and stock movement, and no feeding out on lower terraces.	Where verification is not possible, this should be rectified for the next audit. Followin this – non compliance.
Annual audit of OVERSEER nutrient budget and report based on previous 3 years. Submission of compliance with thresholds.	Should the OVERSEER report show losses exceeding the threshold, further mitigations should be adopted to effect a reduction in nutrient loss to below thresholds.

Reconciliation of fertiliser and soil records with nutrient budget and fertiliser recommendations	Where reconciliation is not possible and an over application has occurred, this should be rectified in the following year. Following that - non compliance
Review measures recommended by irrigation audit have been implemented	Recommendations not already implemented should be done so prior to next audit.
Review of back siphoning prevention measures	Immediate stop of use of unprotected water supply for filling chemical sprayers while permanent measures are put in place. If measures are not in place for following audit - non compliance.
Review of fallen stock policy - use of a contractor to removed fallen stock	Concerns or absence of policy should be rectified for next audit. Following that - non compliance
Review of chemical management policy - use of contractor, approved handler status, use of a crop adviser	Concerns or absence of policy should be rectified for next audit. Following that - non compliance
Review of no spread zones for fertiliser	Map should be displayed for next audit. Following that - non compliance
Review methods employed for reducing wind blow on cultivated areas	Concerns or absence of methods should be rectified for next audit. Following that - non compliance
Review of crop records to verify rotation of fodder crops and early regrassing after kale crop	Concerns or absence of over rotation should be rectified for next audit. Following that - non compliance
Independent fertiliser spreader and irrigation testing and calibration 1 in 5 years	Spreaders and irrigators not performing should be recalibrated
Additional auditing that can be done either externally or internally	
Submission of silage clamp storage design plans	Once approved, the plans need only to be submitted once
Submission and brief interpretation of soil, water quality, and machinery calibration tests	Where triggers have been exceeded, immediate contingency plans should have been effected and a root cause analysis conducted. The results of which should be presented here. Continual breach - non compliance
Submission of example irrigation schedules and reconciliation with soil moisture monitoring	The restriction of irrigation water to 600 mm/ha is an important driver to efficiency. Other sanctions are unlikely to be necessary to promote water use efficiency.
Annual fertiliser spreader and irrigation testing and calibration	Spreaders and irrigators not performing should be recalibrated
Auditing that must be done internally	
Self certification for application of fertiliser according to code of practice	Any failures in observing the code of practice for applying fertiliser should be rectified and followed up in the next audit

Rosehip Orchard Station

149. A suite of scenarios have been modelled for Rosehip Orchard Station, of which four are presented here; lucerne, lucerne and cropping, finishing and bull beef.

150. The irrigated are of Rosehip Orchard Station, according to the WQS, lies in the Tekapo at Benmore surface water subcatchment and in the Pukaki groundwater subcatchment (GHD, 2009).

151. The local receiving environments for Rosehip Orchard Station that are not considered in the WQS are the wetland areas on the property's western boundary.

152. The Twizel River wetlands are located on the floodplain of the Twizel River and run along most of the eastern edge of the property. These areas have recently been turned over to DoC stewardship through the tenure review process. The Bendrose/Dobson soils association identified here (Webb, 1992) has poorly drained Dobson soils that are periodically wet.

Rosehip Orchard Station- WQS Thresholds

153. A table showing the proposed whole farm losses from WQS, the WQS thresholds and the OVERSEER modelling outputs (modelling the proposed system with mitigations) is shown below. For this farm, the N mitigation requirements are most stringent for the Pukaki Groundwater and there are no mitigation requirements for P. The WQS thresholds set Rosehip Orchard Station's nutrient discharge allowance at 6,347kg N and 317 kg P per annum.

154. However, in a subcatchment agreement between those stations (in this consenting process) in the Pukaki groundwater subcatchment, it has been agreed that insofar as possible, a reallocation will occur to enable all applicants to have a degree of flexibility in their proposed farming systems. The sub-catchment agreement is outlined by Mr Peter Glasson in his evidence. In this case, Rosehip Orchard Station can be reallocated any amount of N and P which will be met by other stations' cushion between their OVERSEER losses and their NDAs. In this case the maximum reallocation has been 15,851 kg N and 170 kg P. A full table showing the mitigaiton requirements for each receiving environment and the original predicted losses are given in each FEMP attached to this evidence.

Table 14: Total N and P losses modelled by OVERSEER for the proposed farming system on Rosehip Orchard and WQS thresholds (Developed setting)

	Proposed losses from WQS	**WQS threshold [8] kg/year**	**OVERSEER modelling outputs kg/year**			
			Lucerne (Luclamb (Luc))	Cropping (Crop15)	Finishing (SBIFIN)	Bull beef (BULL)
Total N leaching/ runoff	8,238	6,347+15,851 = 22,198	16,492 (7,582)	16,492	7,582	7,582
Total P leaching/ runoff	317	317+170 = 487	487 (487)	487	163	406

155. On a per hectare basis over the entire farm, this gives an N loss of between 7.8 and 17 kg/ha and a P loss of between 0.2 and 0.5 kg/ha. These losses are comparable with the range quoted for typical sheep and beef farms in New Zealand of 5-20 kg N/ha (OVERSEER v.5.4.3), despite the inclusion of cropping in some scenarios.

156. The table below show modelled losses using the highly developed setting for each of the scenarios. This setting allows for no immobilisation of N and is therefore conservative and represents the upper bound of N losses for the systems as they are described and modelled in OVERSEER 5.3.4. This table illustrates that all of the scenarios presented meet their NDAs using a Highly Developed setting.

[8] Including reallocation from other stations in Pukaki groundwater sub-catchment or direct from SH/SP

Table 15: Total N and P losses modelled by OVERSEER for the proposed farming system on Rosehip Orchard and WQS thresholds (Highly Developed setting)

	Proposed losses from WQS	WQS threshold[9] kg/year	OVERSEER modelling outputs kg/year			
			Lucerne	Cropping	Finishing	Bull beef
Total N leaching/ runoff	8,238	6,347+15,851 = 22,198	16,492 (7,582)	22,126	10,822	13,252

Rosehip Orchard Station – Proposed farming systems with mitigations

157. The first proposed farming system on Rosehip Orchard Station is an irrigated system specialising in producing lucerne supplements. During the season three cuts are taken; one hay crop, a baleage and a silage crop. The fourth crop is left for grazing lambs (Ogle, 2009). A variation on this farm system is simple lucerne with no grazing.

158. The second proposed farming system on Rosehip Orchard Station is similar to the lucerne option, but where more crops are grown during the break. In this system, lucerne occupies approximately 85 % of the area, with the remainder in arable or fodder cropping (Ogle, 2009). As with the scenario 1, during the season three cuts are taken from the lucerne; one hay crop, a baleage and a silage crop. The fourth crop is left for grazing lambs (Ogle, 2009).

159. The third proposed farming system on Rosehip Orchard Station is a fattening or finishing option. In this system, the irrigated areas are used as a fattening enterprise to finish store stock, either on its own or with an associated high country run (Ogle, 2009). Supplements are grown to feed in autumn and to sell to neighbouring properties and a 50:50 ratio of sheep and beef is assumed (Ogle, 2009).

160. The fourth proposed farming system on Rosehip Orchard Station is a bull beef finishing enterprise (Ogle, 2009).

161. There is one main and two subsidiary soil series on Rosehip Orchard Station, Mackenzie soils, an association of Bendrose/Dobson soil series and an

[9] Including reallocation from other stations in Pukaki sub-catchment or direct from SH/SP

association of Bendrose/Larbreck soil series. The Mackenzie soils cover the main outwash plain and all the area proposed to be irrigated. Bendrose/Larbreck association soils occur as a distinct unit adjacent to major rivers (Webb, 1992). On this property they occur on the western perimeter along the course of the Twizel River. Bendrose/Dobson soil series association occurs on young flood plains of the Ahuriri, Grays, Tekapo and Twizel Rivers (Webb, 1992).

162. The FERA highlighted current soils risks are associated with soils vulnerable to wind erosion on the property, the presence of some bare soils (commonly associated with *Heiracium* infestations), and the presence of some surface capping and consolidation of soils. Some of these risks will be greatly reduced with the onset of irrigation and good associated ground cover. Potential additional soils risks arise from the late drilling of winter wheat (scenarios 1 and 2) and the stock damage to wet and wetland soils on lower terraces. The proposed management or mitigation measures are:

- ***The surface of the soil on cropped areas should be protected over winter through leaving previous crop debris on the surface (scenarios 1 and 2);***
- ***Winter wheat should be direct drilled early (scenarios 1 and 2);***
- ***Early regrassing after kale crop as a priority (scenario 3);***
- ***Stock should be fenced off wetland soils; and,***
- ***Stock should be restricted from lower terraces when soil conditions are wet.***

163. In addition, growing the fodder crops as a part of the pasture renewal process thus not mining soil organic matter levels in a few paddocks, should be practiced, and all crops should be direct drilled.

164. Stock. The proposed stock on the station are approximately 7,340 lambs (scenario 1), (or no stock for straight lucerne cropping), approximately 10, 820 lambs and 250 steers (scenario 2), approximately 15,290 lambs and 880 steers (scenario 3) and approximately 2,400 bulls (scenario 4) (Ogle, 2009a).

165. The FERA highlighted potential stock risks associated with stock having access to watercourses and open irrigation races, stock being fed on the lower terraces, stock overwintering outside on the property (scenarios 3 and 4) and there being no provisions for fallen stock (scenarios 3 and 4). The proposed management or mitigation measures are:

- ***Stock will be restricted from any watercourses or open irrigation races;***
- ***No stock will be fed out on the lower terraces of the property; and***
- ***All fallen stock will be removed from the property (scenarios 3 and 4).***

166. Effluent infrastructure and silage - The FERA highlighted potential effluent risks associated with direct discharges occurring off the yard and from silage liquor[10] not being collected and spread to land and that direct discharges may be occur from the silage pits (scenario 3).

167. The proposed management or mitigation measures are:

- ***No direct discharges to occur off the yard.***
- ***Silage is made and stored on a concrete pad and drains to an effluent collection facility (scenario 3); and,***
- ***The silage liquor will be recycled to land (scenario 3).***

168. In addition, no baleage should be stored within 20 m of a watercourse, 50 m of a bore or on the lower terrace.

169. Fertiliser - Specific fertiliser recommendations will be produced on an annual basis using a recommended system. Plant nutrient supply will be estimated from inorganic fertilisers as well as N fixation and animal return using a nutrient budgeting system. No N fertiliser is required on the lucerne crop. The irrigated areas are maintained at or below an Olsen P of 25.

170. The FERA highlighted potential fertiliser risks arising from larger than 50 kg/ha applications of N fertiliser (scenarios 1, 2, 3), late autumn and winter applications of fertiliser (scenarios 1, 2, 3), soil Olsen P increasing above 25, fertiliser applications on the lower terraces, and from no suitable storage and filling area being identified. The proposed management or mitigation measures are:

- ***Soil Olsen P levels to be maintained at or below 25;***
- ***Split applications of N fertiliser to <50 kg N/ha (scenarios 1, 2, 3);***
- ***No N fertiliser in late autumn or early winter (scenarios 1, 2, 3);***
- ***No fertiliser to be applied to the lower terraces;***
- ***Fertiliser to be stored in a covered area;***

[10] All facilities containing silage and silage liquor must be of the appropriate specification as the liquor is highly corrosive.

- ***The identified filling areas will be at least 50 m from a watercourse, spring or bore and will have no drains that discharge to clean water or that can discharge direct to ground; and,***
- ***If liquid fertilisers are used, fertiliser should be stored in a bunded tank and protected from vehicle movements.***

171. In addition, the soils will be regularly tested.

172. Chemical - The FERA highlighted that no chemical management strategy was in place. To satisfy the issues raised in the FERA the proposed management measures are:

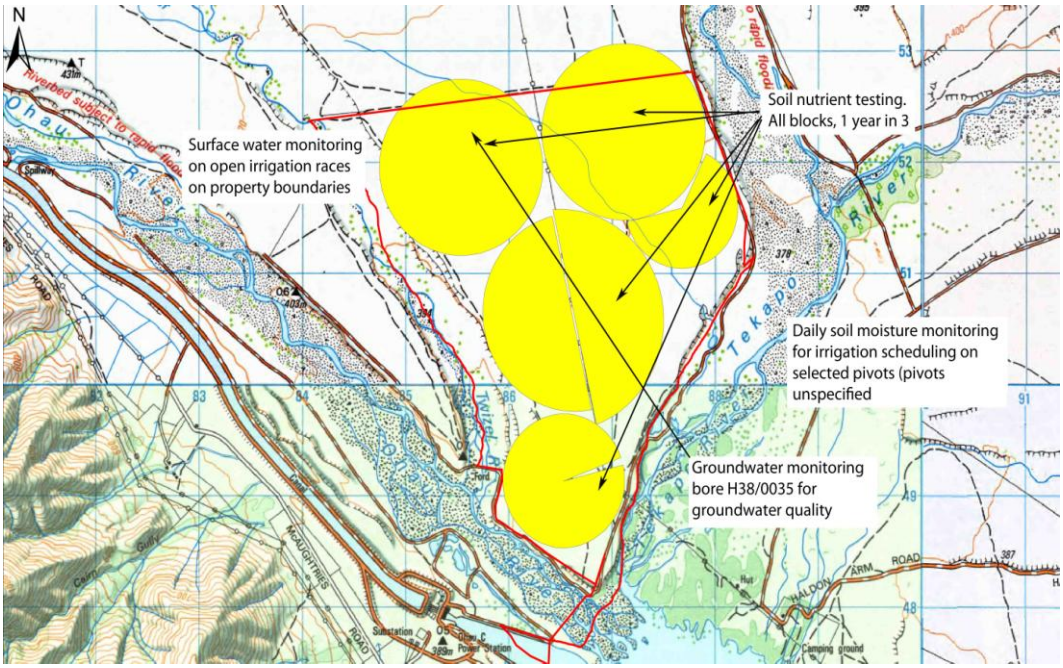
- ***A contractor or approved handler to be used to supply, handle, and apply chemicals on the farm;***
- ***The services of a professional crop adviser or other suitably qualified person to be used to advise on pesticide options, doses and tank mixes; and,***
- ***Back siphoning prevention measures will be implemented on the farm when filling sprayers from an un-isolated water supply***

173. Water/runoff/tracks - The FERA highlighted potential risks arising from runoff associated with soil damage on lower terraces. The proposed management or mitigation measure is:

- ***Stock should be withdrawn from lower terrace when soil conditions are wet.***

174. The environmental monitoring plan for Rosehip Orchard Station is shown below.

Figure 5 Environmental monitoring on Rosehip Orchard Station



175. An annual auditing plan has been prepared for Rosehip Orchard Station. The audit plan addresses both compliance with the WQS thresholds and the management plan options implemented to address identified site-specific environmental issues.

Table 16: Proposed contents of an annual audit for Rosehip Orchard for scenarios 1, 2, 3 and 4

Audit measures	Action in the case of non-compliance if applicable	Applicable scenarios
Additional auditing that must be done externally		
Check yards for evidence of likelihood of direct discharges of contaminated water	If direct discharges are found, temporary barriers should be put in place until permanent structures can be implemented to prevent discharges of contaminated water	1,2,3,4
Review field records and OVERSEER for direct drilling and early drilling of wheat, no late autumn and winter N fertiliser applications, split applications of N fertiliser and no fertiliser applied to lower terrace.	Where verification is not possible, this should be rectified for the following year - following that - no compliance	1,2
Review field records and OVERSEER for direct drilling, early regrass after kale, no late autumn and winter N fertiliser applications, split applications of N fertiliser and no fertiliser applied to lower terrace.	Where verification is not possible, this should be rectified for the following year - following that - no compliance	3

Review field records and OVERSEER for direct drilling and no fertiliser applied to lower terrace.	Where verification is not possible, this should be rectified for the following year - following that - no compliance	4
Review of stock movement records to show no stock on lower terrace when wet, and no stock fed out on lower terraces.	Where verification is not possible, this should be rectified for the following year - following that - no compliance	1,2,3,4
Check fertiliser storage and filling area.	There should be no possibility of loss of fertiliser to drains or direct discharge to ground. Any drains should be covered, or the filling area moved to where no discharges will occur.	1,2,3,4
Check the storage of silage for visible signs of discharge and destination of silage liquor	All liquid should drain into effluent storage. Any discharge must be stopped immediately. Temporary barriers such as straw bales may be used to take up any discharges until permanent structures are in place	3
Annual audit of OVERSEER nutrient budget and report based on previous 3 years. Submission of compliance with thresholds.	Should the OVERSEER report show losses exceeding the threshold, further mitigations should be adopted to effect a reduction in nutrient loss to below thresholds.	1,2,3,4
Reconciliation of fertiliser and soil records with nutrient budget and fertiliser recommendations	Where reconciliation is not possible and an over application has occurred, this should be rectified in the following year. Following that - non compliance	1,2,3,4
Check wetland, Ohau, Pukaki, Tekapo and Twizel River and open irrigation race fencing is in tact	Any failure in the integrity of the fencing must be repaired immediately or a temporary barrier placed around gap to prevent stock access.	1,2,3,4
Review measures recommended by irrigation audit have been implemented	Recommendations not already implemented should be done so prior to next audit.	1,2,3,4
Review chemical management policy	Concerns or absence of policy should be rectified for next audit. Following that - non compliance	1,2,3,4
Review of back siphoning prevention measures	Immediate stop of use of unprotected water supply for filling chemical sprayers while permanent measures are put in place. If measures are not in place for following audit - non compliance.	1,2,3,4
Independent fertiliser spreader and irrigation testing and calibration 1 in 5 years	Spreaders and irrigators not performing should be recalibrated	1,2,3,4
Review of fallen stock policy - use of a contractor to removed fallen stock	Concerns or absence of policy should be rectified for next audit. Following that - non compliance	3,4
Additional auditing that can be done either externally or internally		
Submission and brief interpretation of soil, water quality, and machinery calibration tests	Where triggers have been exceeded, immediate contingency plans should have been effected and a root cause	1,2,3,4

	analysis conducted. The results of which should be presented here. Continual breach - non compliance	
Submission of silage clamp storage design plans	Once approved, the plans need only to be submitted once	3
Submission of dated photographs showing maintained trash or green cover on cropped soils.	Evidence of soils left bare should be queried and rectified in the following year. Following that- non compliance	1,2
Submission of example irrigation schedules and reconciliation with soil moisture monitoring	The restriction of irrigation water to 600 mm/ha is an important driver to efficiency. Other sanctions are unlikely to be necessary to promote water use efficiency.	1,2,3
Annual fertiliser spreader and irrigation testing and calibration	Spreaders and irrigators not performing should be recalibrated	1,2,3,4
Submission of dated photographs showing early and direct drilled winter wheat	Where verification is not possible, this should be rectified for the following year, following that - non compliance	1,2
Auditing that must be done internally		
Self certification for application of fertiliser according to code of practice	Any failures in observing the code of practice for applying fertiliser should be rectified and followed up in the next audit - following that - non compliance	1,2,3,4

High Country Rosehip Station

176. A suite of scenarios have been modelled for High Country Rosehip Station, of which two are presented here; lucerne and finishing.

177. The irrigated area of High Country Rosehip Station, according to the WQS, lies in the Twizel River surface water subcatchment and in the Pukaki groundwater subcatchment (GHD, 2009).

178. The local receiving environments for High Country Rosehip Station that are not considered in the WQS are the wetland areas on the property boundary, both east and west.

179. The Ohau River wetland is on the lower terrace of the Ohau River close to the Ruataniwha spillway beyond the western boundary of the property. The Bendrose/Larbreck soil association indentified here (Webb, 1992) characteristically includes incursions of poorly drained Dobson soils in wet depressions. Land use activity on the irrigated areas is unlikely to impact on this area (based on GHD groundwater flow maps, GHD, 2009b), however activities on the remainder of the farm, for example stock encroachment, could impact on this receiving environment.

180. The Twizel River wetlands are located on the floodplain of the Twizel River and run along most of the eastern edge of the property. These areas have recently been turned over to DoC stewardship through the tenure review process. The Bendrose/Dobson soils association identified here (Webb, 1992) has poorly drained Dobson soils that are periodically wet. During my site visit, some test soil pits dug indicated periodic waterlogging, identified by smell.

High Country Rosehip Station- WQS Thresholds

181. A table showing the proposed whole farm losses from WQS, the WQS thresholds and the OVERSEER modelling outputs (modelling the proposed system with mitigations) is shown below. For this farm, the N mitigation requirements are most stringent for the Pukaki Groundwater and there are no mitigation requirements for P. The WQS thresholds set High Country Rosehip Station's nutrient discharge allowance at 5,923 kg N and 288 kg P per annum. Both scenarios meet the NDA for N but the lucerne option is marginally over for P. It is recommended that further modelling of this option be carried out to include additional P loss mitigation measures.

182. However, in a subcatchment agreement between Simons Hill/ Simons Pass stations in the Pukaki groundwater subcatchment, it has been agreed that insofar as possible, a reallocation will occur to enable Rosehip properties to have a degree of flexibility in their proposed farming systems. The sub-catchment agreement is outlined by Mr Kelvin Reid in his evidence. In this case, High Country Rosehip Station can be reallocated a maximum of 4.1 kg N/ha (for 500 ha) from the subcatchment. This 4.1 kg N encompasses the 3.1 kg N/ha mitigation requirement for groundwater (which will be met by Simons Hill/Simons Pass stations' cushion between their OVERSEER losses and their NDAs11[1]), and the assimilative capacity in the system for the Twizel surface water node at 1 kg N/ha (GHD, 2009). There is 9 kg of assimilative capacity for phosphorus at the Twizel node point (GHD, 2009). A full table showing the mitigation requirements for each receiving environment and the original predicted losses are given in each FEMP attached to this evidence.

Table 17: Total N and P losses modelled by OVERSEER for the proposed farming system on High Country Rosehip and WQS thresholds using a Developed setting.

	Proposed losses from WQS	WQS threshold[12] kg/year	OVERSEER modelling outputs kg/year	
			Lucerne (Luc)	Finishing (SBIFIN)
Total N leaching/ runoff	7473	5,923 + 2,050 = 7973	5,720	5,720
Total P leaching/ runoff	288	288 + 9 = 297	307[13]	107

183. On a per hectare basis over the entire farm, this gives an N loss of 6.5 kg/ha and a P loss of between 0.1 and 0.35 kg/ha. These losses are comparable with the bottom of the range quoted for typical sheep and beef farms in New Zealand of 5-20 kg N/ha (OVERSEER v.5.4.3).

184. The table below show modelled losses using the highly developed setting for each of the scenarios. This setting allows for no immobilisation of N and is therefore conservative and represents the upper bound of N losses for the systems as they are described and modelled in OVERSEER 5.3.4. The table below illustrates that all of the scenarios presented meet their NDAs using a Highly Developed setting.

Table 18: Total N and P losses modelled by OVERSEER for the proposed farming system on High Country Rosehip and WQS thresholds (Highly Developed setting)

	Proposed losses from WQS	WQS threshold[14] kg/year	OVERSEER modelling outputs kg/year	
			Lucerne (Luc)	Finishing (SBIFIN)

[12] Including reallocation from other stations in Pukaki groundwater sub-catchment or direct from SH/SP
[13] Further investigation is recommended to model mitigating measures to reduce P.
[14] Including reallocation from other stations in Pukaki groundwater sub-catchment or direct from SH/SP

	Proposed losses from WQS	WQS threshold[14] kg/year	OVERSEER modelling outputs kg/year	
Total N leaching/ runoff	7473	5,923 + 2050 = 7973	5720	7720

High Country Rosehip Station – Proposed farming systems with mitigations

185. The first proposed farming system on High Country Rosehip Station is an irrigated system specialising in producing lucerne supplements. During the season between three and five cuts are taken of hay, baleage and silage.

186. The second proposed farming system on High Country Rosehip Station is a fattening or finishing option. In this system, the irrigated areas are used as a fattening enterprise to finish store stock, either on its own or with an associated high country run (Ogle, 2009). Supplements are grown to feed in autumn and to sell to neighbouring properties and a 50:50 ratio of sheep and beef is assumed (Ogle, 2009).

187. There is one main and two subsidiary soil series on High Country Rosehip Station, Mackenzie soils, an association of Bendrose/Dobson soil series and an association of Bendrose/Larbreck soil series. The Mackenzie soils cover the main outwash plain and all the area proposed to be irrigated. Bendrose/Larbreck association soils occur as a distinct unit adjacent to major rivers (Webb, 1992). On this property they occur on the western perimeter along the course of the Ohau River. Bendrose/Dobson soil series association occurs on young flood plains of the Twizel River (Webb, 1992).

188. The FERA highlighted current soils risks are associated with soils vulnerable to wind erosion on the property, the presence of some bare soils (commonly associated with *Heiracium* infestations), cultivated soils exposed over winter, cultivation through an ephemeral watercourse and the presence of some surface capping and consolidation of soils. Some of these risks will be greatly reduced with the onset of irrigation and good associated ground cover. Potential additional soils risks arise from the late drilling of winter wheat and the stock damage to wet and wetland soils on lower terraces. The proposed management or mitigation measures are:

- ***Ephemeral channel should be maintained under grass;***
- ***Stock should be fenced off wetland soils; and,***

- ***Stock should be restricted from lower terraces when soil conditions are wet.***

189. In addition, all crops should be direct drilled.

190. Stock. The proposed stock on the station are approximately 24,660 lambs and 1,390 steers (scenario 2) (Ogle, 2009a), and no stock for scenario 1.

191. The FERA highlighted potential stock risks associated with stock having access to Twizel River break out channel and other ephemeral streams and open irrigation races (scenario 2)., stock being fed on the lower terraces (scenario 2)., and there being no provisions for fallen stock (scenario 2). The proposed management or mitigation measures are:

- ***Stock will be restricted from any watercourses or open irrigation races (scenario 2);***
- ***No stock will be fed out on the lower terraces of the property (scenario 2); and***
- ***All fallen stock will be removed from the property (scenario 2).***

192. Effluent infrastructure and silage - The FERA highlighted potential effluent risks associated with direct discharges occurring off the yard (scenario 2).

193. The proposed management or mitigation measures are:

- ***No direct discharges to occur off the yard (scenario 2).***

194. In addition, no baleage or wrapped silage should be stored within 20 m of a watercourse, 50 m of a bore or on the lower terrace.

195. Fertiliser - Specific fertiliser recommendations will be produced on an annual basis using a recommended system. Plant nutrient supply will be estimated from inorganic fertilisers as well as N fixation and animal return using a nutrient budgeting system. No N fertiliser is required on the lucerne crop. The irrigated areas are maintained at or below an Olsen P of 25.

196. The FERA highlighted potential fertiliser risks arising from larger than 50 kg/ha applications of N fertiliser (scenario 2), late autumn and winter applications of fertiliser (scenario 2), soil Olsen P increasing above 25, fertiliser applications on the lower terraces, and from no suitable storage and filling area being identified. The proposed management or mitigation measures are:

- ***Soil Olsen P levels to be maintained at or below 25;***
- ***Split applications of N fertiliser to <50 kg N/ha (scenario 2);***
- ***No N fertiliser in late autumn or early winter (scenario 2);***

- ***No fertiliser to be applied to the lower terraces;***
- ***Fertiliser to be stored in a covered area;***
- ***The identified filling areas will be at least 50 m from a watercourse, spring or bore and will have no drains that discharge to clean water or that can discharge direct to ground; and,***
- ***If liquid fertilisers are used, fertiliser should be stored in a bunded tank and protected from vehicle movements.***

197. In addition, the soils will be regularly tested.

198. Chemical - The FERA highlighted that no chemical management strategy was in place. To satisfy the issues raised in the FERA the proposed management measures are:

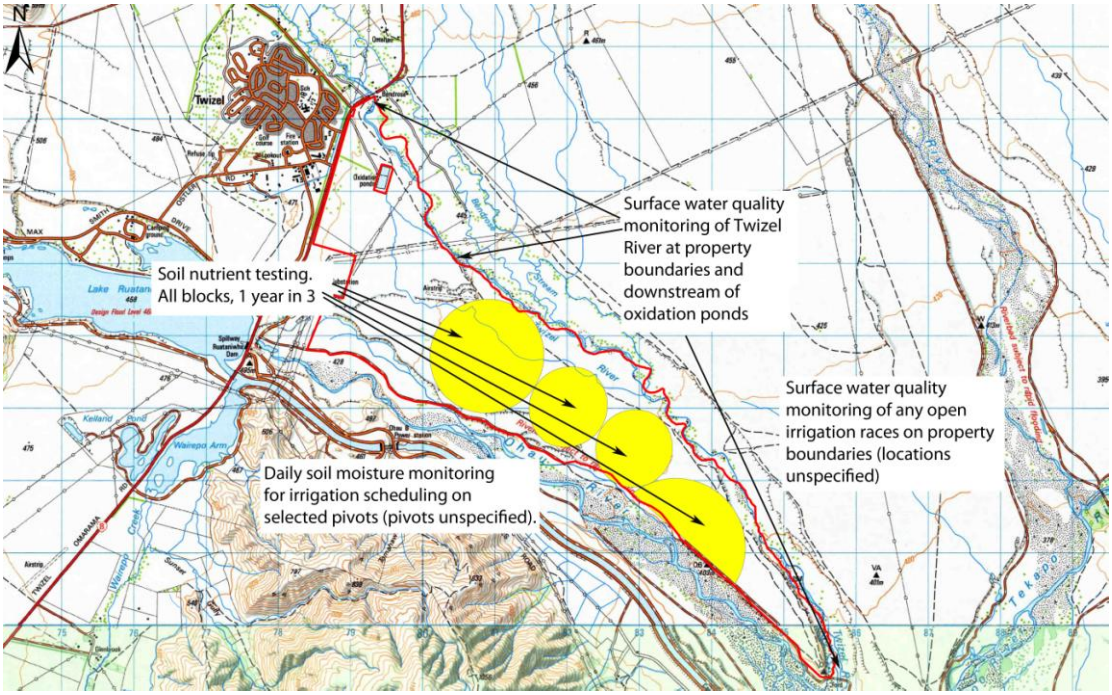
- ***A contractor or approved handler to be used to supply, handle, and apply chemicals on the farm;***
- ***The services of a professional crop adviser or other suitably qualified person to be used to advise on pesticide options, doses and tank mixes; and,***
- ***Back siphoning prevention measures will be implemented on the farm when filling sprayers from an un-isolated water supply***

199. Water/runoff/tracks - The FERA highlighted current risks arising from an ephemeral channel being cultivated risking erosion to the Twizel River and a stock (and occasional vehicle) track passing through a break out channel of the Twizel River and additional potential risks arising from runoff associated with soil damage on lower terraces and heavy machinery accelerating bank slippage into the Twizel. The proposed management or mitigation measures are:

- ***Ephemeral channel should be maintained under grass;***
- ***Stock should be withdrawn from lower terrace when soil conditions are wet (scenario 2); and***
- ***Machinery tracks should be located away from river banks***

200. The environmental monitoring plan for High Country Rosehip Station is shown below.

Figure 6 Environmental monitoring on High Country Rosehip Station



201. An annual auditing plan has been prepared for High Country Rosehip Station. The audit plan addresses both compliance with the WQS thresholds and the management plan options implemented to address identified site-specific environmental issues.

Table 19: Proposed contents of an annual audit for High Country Rosehip Station for scenarios 1 and 2

Audit measures	Action in the case of non-compliance if applicable	Applicable scenarios
Additional auditing that must be done externally		
Check ephemeral channel is grassed, plus photographs	Significant disturbance in vegetation resulting in bare ground should be replanted as soon as practicable.	1,2
Review field records and OVERSEER for direct drilling, early regrass after kale, no late autumn and winter N fertiliser applications, split applications of N fertiliser and no fertiliser applied to lower terrace.	Where verification is not possible, this should be rectified for the following year - following that - no compliance	2
Review field records and OVERSEER for direct drilling and no fertiliser applied to lower terrace.	Where verification is not possible, this should be rectified for the following year - following that - no compliance	1
Check wetland, Ohau and Twizel River and open irrigation race fencing is in tact	Any failure in the integrity of the fencing must be repaired immediately or a temporary barrier placed around gap to prevent stock access.	1,2
Check machinery tracks are located away from river banks		1,2

Check for evidence of direct discharges from the yard area	Any direct discharge must be stopped immediately. Temporary barriers such as straw bales may be used to take up any discharges until permanent structures are in place	2
Check the storage of silage for visible signs of discharge and destination of silage liquor	All liquid should drain into effluent storage. Any discharge must be stopped immediately. Temporary barriers such as straw bales may be used to take up any discharges until permanent structures are in place	2
Check fertiliser storage and filling area.	There should be no possibility of loss of fertiliser to drains or direct discharge to ground. Any drains should be covered, or the filling area moved to where no discharges will occur.	1,2
Review of stock movement records to show no stock on lower terrace when wet, no stock fed out on lower terraces and stock removed when ephemeral channels are flowing.	Where verification is not possible, this should be rectified for the following year - following that - no compliance	2
Annual audit of OVERSEER nutrient budget and report based on previous 3 years. Submission of compliance with thresholds.	Should the OVERSEER report show losses exceeding the threshold, further mitigations should be adopted to effect a reduction in nutrient loss to below thresholds.	1,2
Reconciliation of fertiliser and soil records with nutrient budget and fertiliser recommendations	Where reconciliation is not possible and an over application has occurred, this should be rectified in the following year. Following that - non compliance	1,2
Review measures recommended by irrigation audit have been implemented	Recommendations not already implemented should be done so prior to next audit.	1,2
Review of back siphoning prevention measures	Immediate stop of use of unprotected water supply for filling chemical sprayers while permanent measures are put in place. If measures are not in place for following audit - non compliance.	1,2
Review of fallen stock policy - use of a contractor to removed fallen stock	Concerns or absence of policy should be rectified for next audit. Following that - non compliance	2
Review of chemical management policy - use of contractor, approved handler status, use of a crop adviser	Concerns or absence of policy should be rectified for next audit. Following that - non compliance	1,2
Review of no spread zones for fertiliser	Map should be displayed for next audit. Following that - non compliance	1,2
Independent fertiliser spreader and irrigation testing and calibration 1 in 5 years	Spreaders and irrigators not performing should be recalibrated	1,2

Additional auditing that can be done either externally or internally		
Submission of silage clamp and effluent storage design plans	Once approved, the plans need only to be submitted once	2
Submission and brief interpretation of soil, effluent, water quality, and machinery calibration tests	Where triggers have been exceeded, immediate contingency plans should have been effected and a root cause analysis conducted. The results of which should be presented here. Continual breach - non compliance	1,2
Submission of example irrigation schedules and reconciliation with soil moisture monitoring	The restriction of irrigation water to 600 mm/ha is an important driver to efficiency. Other sanctions are unlikely to be necessary to promote water use efficiency.	1,2
Annual fertiliser spreader and irrigation testing and calibration	Spreaders and irrigators not performing should be recalibrated	1,2
Auditing that must be done internally		
Self certification for application of fertiliser according to code of practice	Any failures in observing the code of practice for applying fertiliser should be rectified and followed up in the next audit	1,2

Response to Section 42a Reports

202. Paragraphs 83 and 84 of Report 33A, paragraphs 85 and 86 of Report 34A, paragraphs 73 and 74 of Report 33C, and paragraphs 75 and 76 of Report 34C state that although the mitigations by the applicant are generally appropriate as a means of reducing potential nutrient leaching and runoff, there are no proposed buffer zones on water bodies, wetlands, tributaries or flood channels. The Mary Burn and Pukaki and Tekapo river beds are already or are proposed to be protected from stock, and in the cases of the Tekapo and Pukaki river beds, both are beyond the border of the property. No stock will be fed out on lower terraces bordering the watercourses, nor will there be any irrigation on the lower terrace, and rivers and river beds are or will be fenced. The existing DoC wetland on the Simons Hill station is already fenced and protected from stock, and the existing riparian vegetation is to be maintained along the Mary Burn. The flood channels, of the type seen during my field visit are reported to flow perhaps once in ten years. It would not be appropriate in my opinion to place buffer strips for nutrient removal for channels that flow this infrequently. In addition, on dryland, it is unlikely that the plants could establish and survive. On the outwash plains, no flood channels were observed and it is unlikely that given the permeability of these soils that significant overland flow to these channels would occur, thereby rendering buffer strips for nutrient removal purposes, ineffective.

203. Paragraph 94 of Report 33A and paragraph 83 of Report 33C state that the applicant has underestimated the potential nitrate-N leaving the property. The applicant has undertaken extensive farm system and nutrient modelling to ascertain a range of likely losses from the station. These are given in the FEMP and also in this evidence and the evidence of Dr Snow, and find that the 48,000 kg N loss is above the top end of what has been predicted across the scenarios for Simons Hill Station (31,122 kg N – 43,267 kg N), and just above the top end what has been modelled for Simons Pass Station (35,958- 50,660 kg N). Under a highly developed setting in OVERSEER assuming no immobilisation of N, these increase to 39,950 – 48,625 kg N for Simons Hill and 43,799 - 56,541 kg N for Simons Pass

204. Paragraph 33 of Report 33B and Report 34B states that unused irrigation water will have decreased in quality when it is discharged as stock may have access. There will be no stock access to this irrigation race.

205. Paragraph 35 of Reports 33B and 34B states that a change in the water quality of Lake Pukaki may contribute to the cumulative effects on Lake Benmore. It is extremely unlikely that there will be any change in the water quality of Lake Pukaki as there is virtually no current or proposed irrigation in its catchment (GHD, 2009).

206. Paragraph 36 of Report 33B and 34B states that soils may become saturated and result in contaminants being carried to groundwater and affecting water quality when clean water is discharged to ground. These discharge areas will be on dryland soils that are not in intensive production, therefore the quantity of nutrients available to be lost are likely to be very small. However should this discharge take place where there is intensive land use, there will be an increased risk of nutrient loss.

207. Paragraph 44 of Report 33B and Report 34B states that it is unclear how the water quality in the Pukaki River will be maintained. In paragraph 32 the report states that the existing flow regime in the Pukaki is dependent on infrequent large scale releases from the Pukaki spillway. The water quality, when there is water in the river, is therefore largely a function of the water quality in Lake Pukaki. Additionally, in the WQS, the lower part of the Pukaki River and below the confluence with the Tekapo has been modelled and nodal limits set to maintain water quality (GHD, 2009).

208. Paragraph 44 goes on to suggest that the cumulative effects of the proposed development on Lake Benmore have not been assessed. This is not correct.

The losses from the originally proposed farm systems have been modelled in terms of their impact on the trophic level of Lake Bemore (GHD, 2009).

209. Paragraph 89 of Report 34A states that the applicant has not considered the potential for leaching to enter the Mary Burn. This is incorrect. The water and ecological quality in the Mary Burn has been assessed in the WQS (GHD, 2009). In addition, site-specific measures have been recommended in the FEMP in the irrigation adjacent to the Mary Burn on shallower soils.

210. Paragraph 60 in Report 19 A, paragraph 57 in Report 32C paragraph 59 in Report 32A state that the proposed activities can have an impact on the water quality in the immediate vicinity of the development and in combination with other activities result in cumulative adverse effects.

211. In putting together the FEMP, an on-farm site-specific environmental risk assessment was conducted to identify and address both current and potential risks to local receiving environments, which on these stations includes including rivers and wetlands, and in meeting the WQS thresholds, the losses from Rosehip Orchard and High Country in themselves and in conjunction with other stations in the sub-catchment are having a less than minor effect on the lake systems.

Response to submitters

212. DoC expresses concern that no significant mitigation has been offered for the potential adverse effects. For each scenario in the suite of proposed farm systems being considered, mitigations have also been recommended, with significant measures targeted at reducing winter losses of nutrients, such as wintering cows off the farm completely and using a feedpad whereby excreted nutrients can be collected and reapplied to the land at a rate that can be used by the plant. To ensure that all the measures recommended are implemented on the farm, the FEMPs have both an environmental monitoring plan and an annual auditing plan. These plans allow the farmer to demonstrate, and the regulatory authority and other interested parties to have confidence in the plan doing what it sets out to do. Where the measures in the plan are not working, there is a clear mechanism for these to be identified and new measures put in place.

213. Fish and Game express concern that there have been no assessment of cumulative effects on water quality and that an environmental farm plan has not been developed. The outputs and requirements of the WQS, which assesses

the cumulative effects on water quality (limited to N and P), have been incorporated into the prepared FEMPs for each station.

214. Lesley Shand expresses concern stating that there is a probability of adverse effects on the environment, water quality and also expresses concern about the use of dairying. The WQS was undertaken to assess cumulative effect on water quality. The FEMPs submitted for each property clearly demonstrate how the requirements set out in the WQS for the wider environment have been complied with through meeting the farm thresholds or NDAs. In addition, the FEMPs view features such as watercourses and wetlands as local receiving environments to the farm and put in place mitigation and management strategies such that these features are protected. Where dairying is proposed, additional mitigations, such as those to deal with dairy effluent are proposed to minimise additional adverse environmental impacts.

215. Mr and Mrs Gottilebb and A Braun-Elwert state that water quality and temperature monitoring should be performed. An extensive on farm and off farm water quality monitoring strategy is proposed, however at this stage temperature was not a recommended parameter.

216. Stephen Carswell expresses concerns that the more intensive farming and runoff will lead to irreversible degradation in water quality. The nutrient concentrations in the principle watercourse will increase with more intensive land use, however, the thresholds recommended by the WQS maintain the water quality in the principle watercourse below AZECC trigger guidelines (GHD, 2009).

217. Waitaki First Incorporated express concerns based on provisions around the take and use of water, adverse impacts on water quality and monitoring. The first concern related to efficient and appropriate use of water. Mandatory good agricultural practices that are committed to stipulate that the irrigation system must be appropriate to the soils, capable of delivering water to at least 80 % uniformity and must be subject to robust irrigation scheduling which includes the use of technology such as Aquaflex to determine soil moisture deficit. And while monthly reports to ECan on SMD are not envisaged, annual ones are proposed.

218. The second concern raised by Waitaki First Incorporated is that proactive steps need to be taken to decrease the potential risk of adverse impacts of agricultural intensification on water quality. The FEMP process sets out to address the specific environmental issues associated with farming a particular enterprise in each specific location. Concerns are raised about the flushing of bacteria to groundwater through over irrigating. The effluent management

provisions highlighted in the FEMP for mitigating effluent nutrient losses will also be effective for bacteria.

219. Thirdly, Waitaki First Incorporated proposed that monitoring should be in place to monitor the cumulative effects on water quality. A three tier monitoring programme has been proposed combining on farm monitoring and auditing, sub-catchment and catchment scale monitoring to maintain an on-going assessment of the cumulative impacts of the development.

References

DoC (2007). Department of Conservation Leaflet: Simons Hill Conservation Area.

GHD (2009). Cumulative Water Quality Effects of Nutrients from Agricultural Intensification in the Upper Waitaki Basin – Summary Report.

GHD (2009a). Cumulative Water Quality Effects of Nutrients from Agricultural Intensification in the Upper Waitaki Basin – Rivers and Lakes Report.

GHD (2009b). Cumulative Water Quality Effects of Nutrients from Agricultural Intensification in the Upper Waitaki Basin – Groundwater Report.

NZFMRA (2002). Code of Practice for Fertiliser Use. Providing practical and specific guidance for safe, responsible and effective nutrient management.

Olge, G. (2009). Farm system models for land to be irrigated in the Mackenzie basin by Simons Pass Station Limited and Simons Hill Station Limited. Report prepared by Ogle Consulting.

OVESEER v.5.3.4 . AgResearch.

Snow, V., King, W. (2008). Upper Waitaki Farm Systems and Nutrient Assessment. Stage 2: Pasture and Ryecorn Growth Modelling. Report prepared for GHD by AgResearch.

Webb, T. H. (1992). Soils of the Upper Waitaki Basin, South Island, New Zealand, DSIR.