Farm Environmental Management Plan: Ribbonwood Station

1. Introduction

The Water Quality Study ('WQS') funded by Mackenzie Water Research Limited ('MWRL'), found that the additional irrigation proposed in the catchment could take place without significant adverse effects on the environment providing that nutrient reduction occurred on the farms.

The process that was advocated for ensuring this on-farm nutrient reduction was through Farm Environmental Management Planing. A clear process for building a Farm Environmental Management Plan (FEMP) was laid out in the Water Quality Study and has been followed here. An overview schematic of the process of building a FEMP is shown in Appendix A.

The responsibility of the implementation, monitoring and auditing of the plan lies with the **farmer**.

2. Farm Description

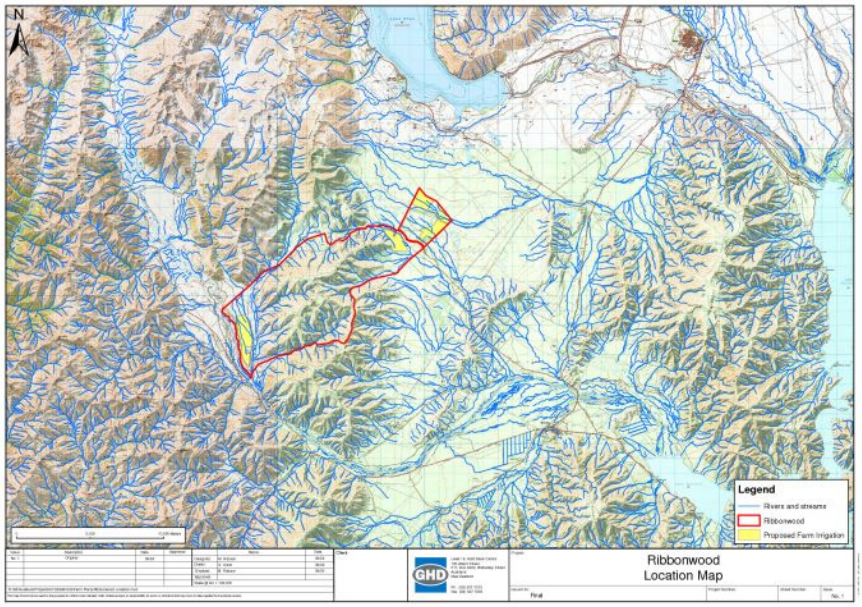
2.1 General farm description

Ribbonwood Station is situated between the Ahuriri River and Lake Ohau. The outwash flats on the Ahuriri River valley floor consist of two main terrace levels. The higher terrace bounds the Ahuriri River mainstem and extends to a lower terrace associated with the East Branch. The upper terrace, on which irrigation is proposed, has been planted in substantial shelter belts (up to 10 rows deep) and forestry blocks which criss-cross the landscape. Overall the terraces are highly modified with predominantly over sown pasture species.

The property is 7,289 hecatres, and carries 11,300 stock units (8,000 as sheep and 3,300 as beef cattle).

As the property is fully developed within normal economic parameters, irrigation is now required to take the property to the next production step.

Farming practice now without water involves a fine wool, sheep and cattle breeding and store stock unit in a high country environment. Stock are currently sold on the store market which has distinct limitations in dry seasons and in terms of market options. It is considered that with irrigation all progeny bred on the property will be able to be finished if the irrigation system is installed as planned.



Location Plan

Table 1. Cover utilisation by season and stock class for current system

	Cover utilisation by season and stock class - CURRENT			
Class of stock	**Spring**	**Summer**	**Autumn**	**Winter**
Ewes	Oversown hill	Oversown hill	Oversown hill	Oversown hill
Hoggets	Improved Dryland	Improved Dryland	Improved Dryland	Improved Dryland
Breeding cows	Improved Dryland	Improved Dryland	Native	Native
R1 Steers & Heifers	Improved Dryland	Improved Dryland	Improved Dryland	Improved Dryland

2.2 Proposed farming system

Irrigation is proposed for 532 hectares.

Table 2. Cover utilisation by season and stock class for proposed system

	Cover utilisation by season and stock class - PROPOSED			
Class of stock	**Spring**	**Summer**	**Autumn**	**Winter**
Ewes	Oversown hill	Oversown hill	Oversown hill	Oversown hill
Hoggets	Irrigation/Improved Dryland	Irrigation	Irrigation	Irrigation/Improved Dryland
Breeding cows	Improved Dryland	Improved Dryland	Native	Native
R1 Steers & Heifers	Irrigation/Improved Dryland	Irrigation	Irrigation	Irrigation/Improved Dryland

2.3 Soils

The property has a mix of soil types, ranging from 40mm PAW to in excess to 110mm.

Soils on the heavy flats are of the Craigieburn silt loam series involving 15-20 cm of silt loam on silt and gravels ex native cover of red and fescue tussock grassland with small patches of lowland scrub of low natural fertility status. The soils are derived from a parent material of greywacke loess over gravels with alluvium in places. They respond well to super phosphate and lime and are prone to severe wind erosion if the soil is left exposed particularly in spring.

Soils throughout this area also include those of the Ohau silt loam series with a thinner subsoil of 10cm of silt loam on 10cm of yellow silt loam on silt and gravels ex native cover of fescue and snow tussock grassland of low to very low natural fertility status. These soils are derived from glacial till with a thin

cover of greywacke loess and respond very well to super phosphate. Once again they are very prone to wind erosion during spring cultivation.

The soils at the rear of the property on the Ahuriri Flats are of the Tekapo silt and sandy silt loam series featuring 10cm of fine sandy loam on 5cm of silt loam on silt and gravels with the interspersement of quite sizeable boulders. The soils are derived from glacial till with thin veneer of loess of medium natural fertility status. Once again they are also prone to wind erosion.

Elsewhere on the property are soils of the Omarama steep land and Tengawai and Puketeraki soils on the hill country and steep lands. None of these are attached to the irrigation programme.

2.4 Topography

The land format of Ribbonwood includes the following:

700 hectares heavy flats either side of the Quailburn Road

490 hectares dry flats north of the Quailburn Road

400 hectares cultivated flats along the Ahuriri River

1260 hectares topdressed and oversown flats adjoining the Ahuriri River

1475 hectares topdressed and oversown hill country

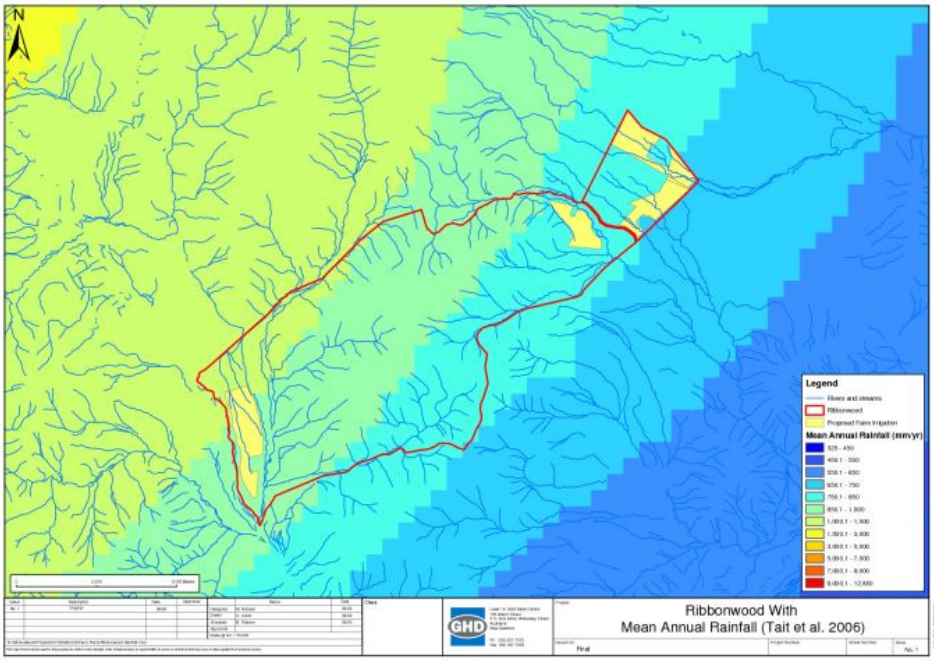
2790 hectares improved native hill country

1169 hectares high inexposed occasional summer grazing tussock country

7289 hectares total

2.5 Rainfall

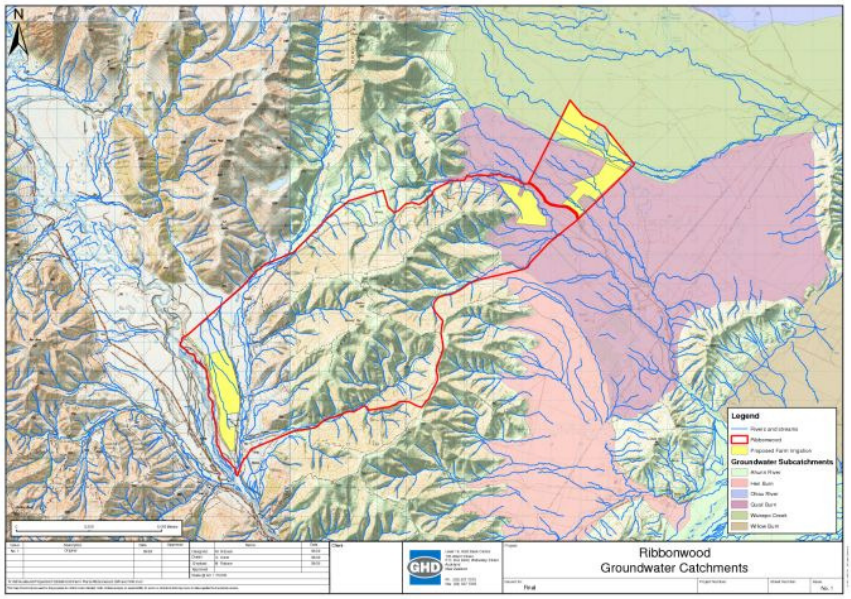
The average annual rainfall measured at the Ribbonwood Homestead is 450mm. It is acknowledged that rainfall is subject to quite substantial variation for the property is located on the fringe of the area which can receive rainfall from the northwest during summer months. This pattern appears to be a relic of the past for in the nine years that the property has been under the current ownership, summer rainfall from the northwesterly quarter has simply not occurred. It would appear that the change in climatic factors is partly the reason involved and on-farm management has adapted in response to this change in climate pattern.



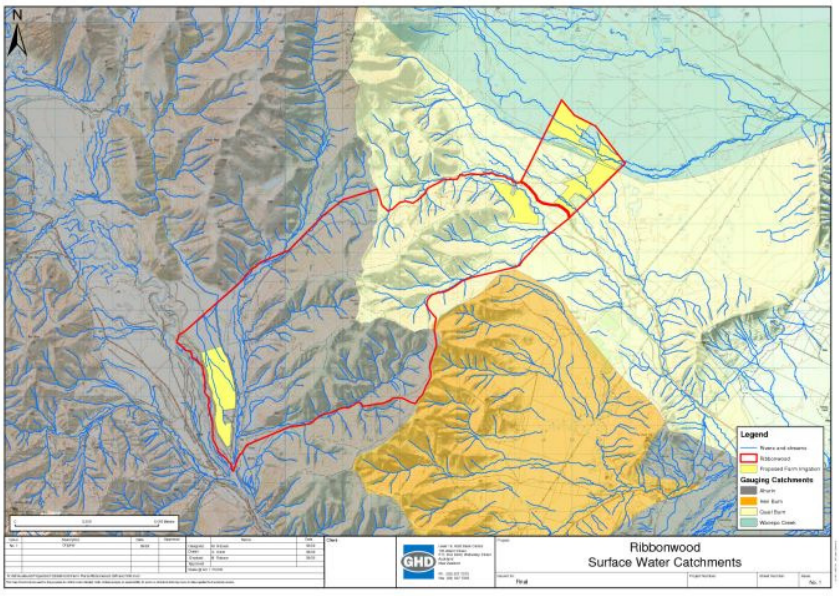
Rainfall Map

3. Environmental Context

The environmental context of the farm is a reference both to local and wider receiving environments.



Groundwater Receiving Environment



Surface Water Receiving Environment

3.1 Water Quality Study receiving environments and mitigation requirements

Ribbonwwod Station, according to the WQS, lies in the Wairepo and Quailburn groundwater catchments, and in the Wairepo, Quailburn and Ahuriri surface water catchments and "Ahuriri Arm" and "Northern" lake catchments.

The following table shows the calculated nutrient mitigation requirement of the receiving environments determined in the WQS and the resulting thresholds for N and P for Ribbonwood Station.

Ahuriri Arm Mitigation required kg/ha irrigated land	Wairepo Stream Mitigation required kg/ha irrigated land	Wairepo Groundwater Mitigation required kg/ha irrigated land	Quailburn Stream Mitigation required for ANZECC kg/ha irrigated land	Quailburn Stream Mitigation required for periphyton kg/ha irrigated land	Ahuriri Stream Mitigation required for periphyton kg/ha irrigated land
N -10.70 P -1.10	N -1.90 P -1.00	N -16.40 P -0.70	N 2.30 P -0.50	N 2.30 P -0.50	N 0.40 and 1.10 P -0.30 and -0.90

For this farm, the Wairepo Groundwater mitigation requirements are the most stringent. These mitigation requirements cap Ribbonwood Station's nutrient discharges at 16,533 kg N per annum and 438 kg P per annum.

3.2 Local receiving environments

The East Branch Ahuriri River is a braided river with a main channel width of between 10 and 15 metres. The depth of the river is around 0.2 to 0.5 metres at normal flows.

Flows range from 200 litres per second to 3,700 litres per second but this is based on limited data. Some flow losses are known to occur between the gorge and its confluence with the mainstem.

Recreational use of the East Branch is limited because of limited access.

The East Diadem is a small stream with many tributaries. Channel width varies from 1 to 3 metres, with a depth of 0.3 to 0.5 metres. No flow data is available but the applicant estimates flows are between 100 and 500 litres per second. In the past water from the East Diadem stream was utilised to generate hydro electricity on the property, although this scheme has long since been abandoned.

There are no recorded users of the East Diadem and the applicant considers there to be no significant native or protected species habitat in the vicinity of the diversion.

The Quail Burn is a small braided river with channel width of 8 to 10 metres and average deepest depth of 0.5 metres with a range of 0.1 to 0.5 metres. Expect flows to range between 60 and 890 litres per second.

There is no significant native wildlife evident.

4. Farm Environmental Management Plan development

4.1 Stage 1 – Mandatory good agricultural practices

The table below shows the mandatory good agricultural practices that will be adopted. These include the base assumptions of OVERSEER and therefore help validate the use of the model on the farm.

Table 5. Mandatory good agricultural practices

Mandatory good agricultural practices	What these practices mean on farm
Fertilisers applied according to code of practice for fertiliser use	The fertiliser users' code of practice aims to ensure that where fertilisers are used that they are used safely, responsibly and effectively and in a way that avoids, remedies or mitigates any adverse environmental effects. The code of practice includes guidance on fertiliser use, application, storage, transport, handling and disposal.
Use a fertiliser recommendation system (nutrient budget) and account for all sources of nutrients including applied effluents and soil reservoirs accounted for	Planning fertiliser applications to all crops, determining crop requirement and accounting for soil nutrients and organic nutrient supplies, all reduce the risks of applying excessive fertiliser above the crop requirement. This maximises the economic return from the use of fertilisers and reduces the risk of causing nutrient pollution of the environment Accounting for all sources of nutrients including imported sources and soil reservoirs is an important management measure in all farming systems and become especially important on farms where manure is produced and applied to the land. The re-application of organic manures to land is often thought of as a disposal of a waste product, and the available nutrients within the organic manures are not accounted for. The use of an integrated nutrient budgeting tool such as OVERSEER automatically accounts for nutrients supplied in organic manures.
Fertiliser application applied evenly	The even application of fertiliser is an assumption of the OVERSEER model as included in the fertiliser code of practice. Fertiliser spreaders should be tested and calibrated in-house at least annually and every 5 years by an independent auditor.
Irrigation and effluent applied evenly	The even application of water and or effluent is an assumption of the OVERSEER model. Irrigators should be tested and calibrated in-house at least annually and then every 5 years in accordance with the code of practice for irrigation evaluation by a qualified irrigation auditor.
Crop, cultivation, nutrient inputs and yield records kept per farm management unit	Maintaining good crop input records is important for: • The calculation of cumulative annual organic fertiliser applications and also their contribution to long term nutrient supply; • The prediction of realistic crop yields that are used to

	determine crop requirements; • Providing accurate inputs to the OVERSEER nutrient budgeting model that is being used here as a proxy for measuring diffuse nutrient losses.
Good design of irrigation systems	Design will match soil properties and low application amounts on shallower soil to prevent summer drainage.
Robust irrigation scheduling	Good irrigation scheduling to prevent summer drainage.
Supplement and feeding out management	To be addressed in the Farm Environmental Risk Assessment.
Winter grazing management	To be addressed in the Farm Environmental Risk Assessment.

4.2 Stage 2 – OVERSEER and meeting WQS mitigation requirements

The WQS thresholds set Ribbonwood Station, using the most stringent nutrient mitigation requirement, are 8,834kg N/year and 237 kg P/year. Table 4 below shows the output from OVERSEER for the modelled proposed farming system at Ribbonwood Station. The results illustrate that the proposed farm system losses as modelled by OVERSEER are within the thresholds. Management or mitigation strategies that have been used to meet this threshold are detailed in Section 5.

A list of OVERSEER model inputs and outputs are attached.

Table 4: Total N and P losses modelled by OVERSEER for the proposed farming system on Ribbonwood Station and WQS thresholds

	Nitrogen Threshold (kg/farm)	Phosphorous Threshold (kg/farm)
MWRL Water Quality Study Property Thresholds	16,533	438
OVERSEER® outputs	16,194	352

4.3 Stage 3 – Identification and mitigation of site specific environmental risks

A full Farm Environmental Risk Assessment (FERA) will be conducted on the farm within 12 months of the consent being granted or before irrigation commences by an independent and suitably qualified professional in conjunction with the farmer. The FERA will assess risks associated with soil, fertiliser, effluent, cropping, stock, water, irrigation, runoff, tracks, pest and weeds, waste disposal and biodiversity.

All environmental risks identified will be addressed and have an appropriate monitoring and auditing strategy. All management strategies chosen to mitigate the site specific environmental risks identified in the FERA will be included in Section 5.

In a workshop held on 17-19th August the following potential issues were highlighted.

a) Evidence of erosion
b) Runoff from winter feed crops
c) Laybacks from waterways from fertiliser application
d) Track runoff - check
e) The many water ways that flow through the property!
f) Fencing off water races
g) Stock access to water ways

The FERA will need to address these issues specifically when carried out.

5. Farm Environmental Management Plan for Bog Roy Station

5.1 Mitigation measures and management options adopted on Ribbonwood Station

The table below shows the all the mitigation and management tools that are proposed to be undertaken on Ribbonwood Station. Measures indicated as **FEMP stage 1 are those identified as Mandatory Good Agricultural Practice**, **measures identified as FEMP stage 2 are those changes that have been modelled in OVERSEER to meet the WQS mitigation requirement (if required)**, and those indicated as **FEMP stage 3 are mitigation measures chosen to ameliorate site specific environmental risks on the farm.** Where the full FERA has not been carried out, the final part of the table will be completed once the assessment has been made.

Table 7 indicates in brief how the measures are to be monitored and audited.

Table 7. Table of mitigation options, monitoring and auditing for Ribbonwood

FEMP stage	Measure	Monitoring	Auditing
1	Fertilisers applied according to code of practice for fertiliser use		Self certification
1	Accounting for all sources of nutrients including applied effluents and soil reservoirs	Soil and effluent testing and cumulative effluent inputs per management unit	Reconciliation of fertiliser, effluent and soil records with nutrient budget for example blocks. Submission of examples soil and effluent tests
1	Even fertiliser application	Calibrate and optimise fertiliser spreaders annually and every 5 years by an external auditor	Submission of testing and calibration
1	Even irrigation and effluent application	Calibrate and optimise irrigators annually in house and every 5 years by an external auditor	Submission of testing and calibration
1	Record crop, cultivation, nutrient inputs and yields per farm management unit	Upkeep of records	Submission of example block records
1	Good design of irrigation systems	Design of irrigation system by a certified professional	Irrigation system audited by a certified auditor every 5 years
1	Robust irrigation scheduling	Calculation of annual % effective water use	Submission of annual % effective water use
2	No winter application of fertiliser	Field records	Signed field records
2	N fertiliser applications split to under 50 kg N/application	Field records	Signed field records
2	No P fertiliser within three weeks of irrigation	Field records	Signed field records

FEMP stage	Measure	Monitoring	Auditing
2	Olsen P of below 30 maintained	Regular soil testing (every 3 years)	Submission of soil tests
3	**e.g.** Fencing stock out of waterways through riparian fencing and planting where appropriate	Surface water testing of race/waterway as it enters and exits the property	Annual auditing visit.
	To be filled in once the FERA is completed		

5.2 Monitoring and Auditing

5.2.1 Baseline monitoring

Baseline monitoring is already underway on Ribbonwood Station.

Table 8. Baseline monitoring on Ribbonwood Station

		Location	Frequency	Measured parameters to include
Soil	Soil nutrient testing	All blocks in rotation	1 in 2 years	Standard suite of soil nutrients, pH C, N and organic matter
Pasture	Ground cover and species	All blocks	As needed	% Ground cover, species
Livestock	Quality and performance	All blocks	Annual programme as needed	Per head performances, monitoring of livestock bodyweights at critical production periods.

5.2.2 On-going monitoring

On going monitoring and auditing of FEMP are as important as the plan itself.

Table 7 above shows the monitoring suggested for the mitigation and management options chosen for Ribbonwood and Table 9 below shows the frequency and parameters for the monitoring. The triggers and contingency plans will be finalised in consultation with farm consultants once the FERA has been completed and all the mitigation measures identified.

Table 9. Example monitoring plan for Ribbonwood Station showing location, frequency and parameters for monitoring

		Location	Frequency	Measured parameters to include	Triggers	Contingency plan if triggers are exceeded
Soil	To include: Soil nutrient testing	All blocks in rotation	1 in 3 years for soil nutrient	Standard suite of soil nutrients, pH C, N and		

		Location	Frequency	Measured parameters to include	Triggers	Contingency plan if triggers are exceeded
			status	organic matter		
Soil	Soil compaction testing	All blocks in rotation	Annually for soil compaction testing.	Soil compaction		
Runoff	Wet weather survey	All blocks	Annually	Runoff		
Water	Surface water quality	Entry and exit of stream X on property boundaries.	XX times per year for first couple of years to establish patterns.	Total Nitrogen, nitrate, ammonia, total Kjeldahl nitrogen, total phosphorus, dissolved reactive phosphorus, E Coli and suspended solids.		
Water	Groundwater quality	Groundwater bore location XX	Annually for groundwater	Total Nitrogen, nitrate, ammonia, total Kjeldahl nitrogen, total phosphorus, and dissolved reactive phosphorus,		
Water	Irrigation application		Annually in house and 1 in 5 years by an independent	Application uniformity	>80 %	Optimisation of the irrigator performance will be performed at the time of testing
Fertiliser	Fertiliser application		Annually in house and 1 in 5 years by an independent	Application uniformity	>80 %	Optimisation of the spreader performance will be performed at the time of testing
Pasture	Ground cover and species	All blocks	2 x per year	% Ground cover and species	>80 %	Soil nutrient and compaction testing should be performed to identify possible causes of poor groundcover
Weed and pest pressures	Weed and pest populations	Relevant blocks	Annually	% or magnitude of infestation		
Livestock		All age groups	3 x per year	Shift in livestock bodyweights and monitored per head performances		

Where triggers are exceeded, the immediate contingency plans in Table 9 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 Tables 7, 9 and 10.

1) Is the current mitigation option implemented correctly?

No – Implement and monitor

Yes – to 2)

2) Has anything changed in the farm system?

Yes – remodel and monitor

No – to 3)

3) Have there been abnormal conditions at the time of trigger breach?

Yes – continue monitoring to see if trigger breach continues

No – Seek advice if suitably qualified person to investigate root cause and suggest appropriate mitigation.

If emergency conditions occur that risk a pollution event, such as a catastrophic failure of the irrigation system that is resulting in overland flow to a watercourse, seek immediate guidance from you regional council:

Environment Canterbury 0800 76 55 88

5.2.3 Auditing

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.

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

The audit measures and actions in case of non-compliance will be finalised once the FERA is completed. Those pertaining to FEMP stages 1 and 2 are included here.

Table 10 below shows an example of an annual audit report for Bog Roy Station.

Table 10. Table showing proposed contents of an annual audit report for Ribbonwood Station

Audit measures	Action in the case of non-compliance
Additional auditing that must be done externally	
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.
Check riparian planting and fencing is present where it should be and that it is intact, plus photographs	Any failure in the integrity of the fencing should be repaired immediately or a barrier placed around gap to prevent stock access until repair is made

Audit measures	Action in the case of 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.
Fertiliser spreader and irrigation testing and calibration 1 in 5 years by independent auditor	Spreaders and irrigators not performing should be recalibrated
Additional auditing that can be done either externally or internally	
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
Submission and brief interpretation of soil, water quality, supplement and machinery calibration tests	Where triggers have been exceeded, immediate contingency plans should have been carried out and a root cause analysis conducted. The results of which should be presented here.
Submission of example irrigation schedules and calculated water use efficiency	Where calculated water use efficiency is such that the trigger is exceeded, remedial action of how the system is to be optimised should be submitted, and followed up in the next audit
Annual soil compaction survey, submission broad findings and remedials	Where poor soil structure is found and cause assessed, the remedials should be implemented and followed up in the next audit
Annual wet weather survey, submission broad findings and remedials	Where runoff is found and cause assessed, the remedials should be implemented and followed up in the next audit
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
Submission of proof of 'approved handler' status	Inappropriate handling of chemicals should cease until an approved handler is in place

6. Summary

This FEMP has been written to serve two purposes, to ensure the proposed farm system can meet the nutrient mitigation requirements set out by the Water Quality Study, and to lay out the process for identification of farm specific environmental risks that arise from the inherent characteristics of the farm or from the proposed farm system and its management and mitigate other. A commitment to complete the full on-farm risk assessment within a pre-determined timeframe has been undertaken as well as the commitment to address the risks identified. These farm specific risks include uncontrolled discharges that are not identified in farm nutrient budget modelling but that may still have an environmental effect.

The mitigation and management measures detailed in Table 7 will lay out the techniques that have been adopted to fulfil these two objectives once the FERA has been completed. The WQS thresholds and modelling outputs from OVERSEER detailed in Section 4 illustrate that the proposed farming system meets the WQS thresholds, and the risk assessment process laid out in Section 4.3 illustrates how site specific environmental issues, including uncontrolled discharges, will be identified and mitigated.

The monitoring and auditing of this plan, addressed in Section 5 allow the performance of the measures chosen to be monitored and where they are performing sub-optimally, these can be addressed through the root cause analysis process.