Farm Environmental Management Plan: Ribbonwood Station (Maree Horo)

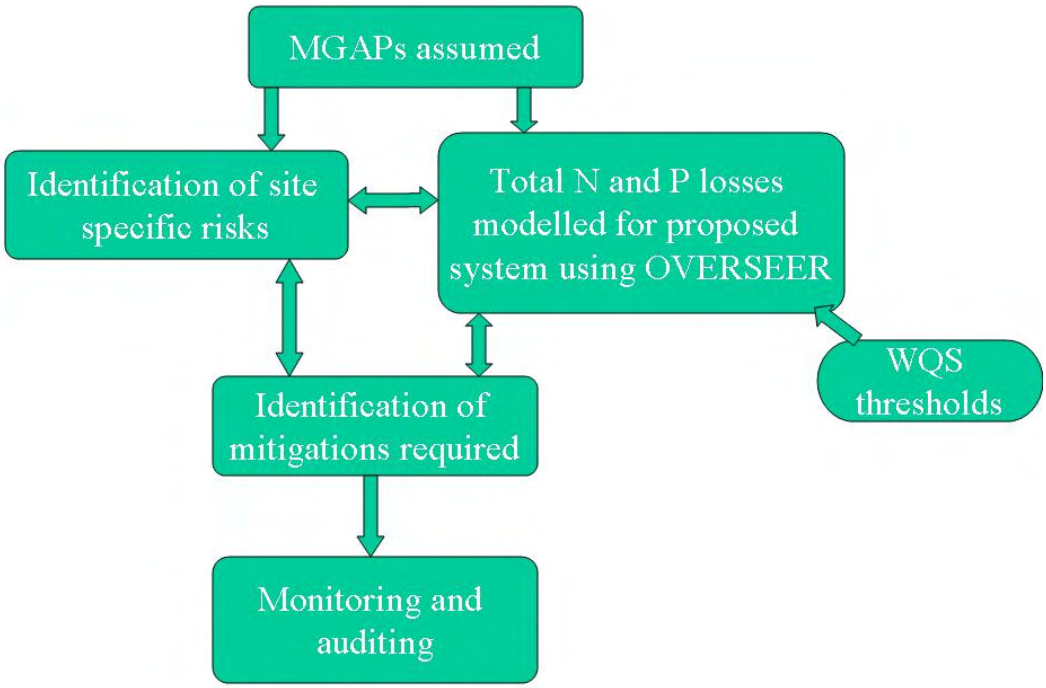
1. Introduction

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 Figure 1.

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

Figure 1: Overview schematic of the process to build a Farm Environmental Management Plan



MGAP – Mandatory good agricultural practices

2. Farm Description

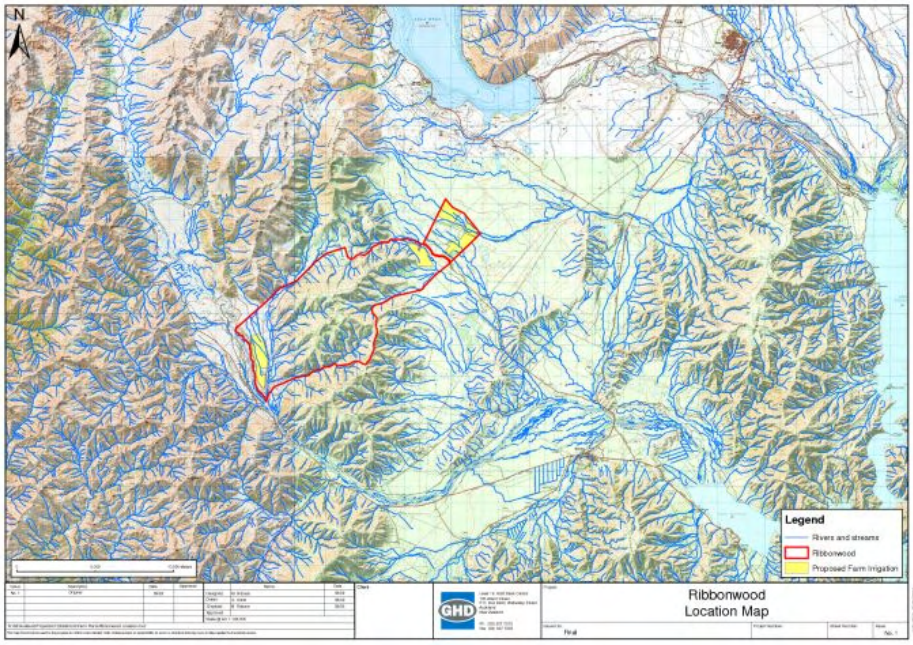
2.1 General farm description

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 main stem 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.



Map A: Location Plan

Photo A: North Branch Serpentine Creek within one of the proposed irrigation areas

Photo B: Proposed irrigation area at East Ahuriri in the background amongst the shelter trees

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

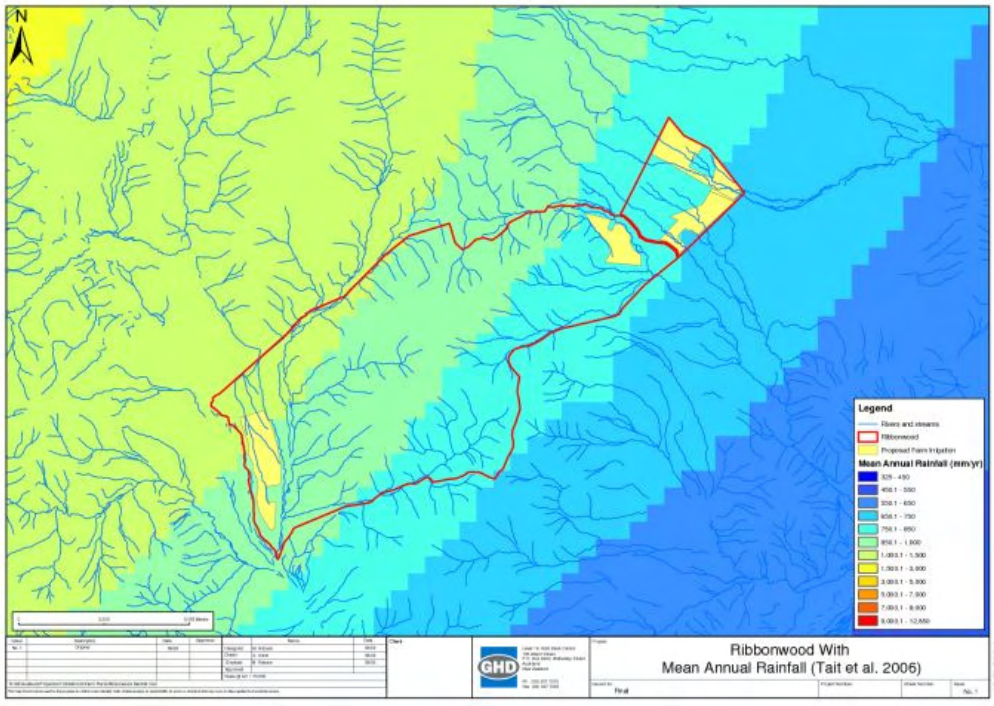
2790 hectares improved native hill country

1169 hectares high inexposed occasional summer grazing tussock country

7289 hectares total

2.5 Rainfall

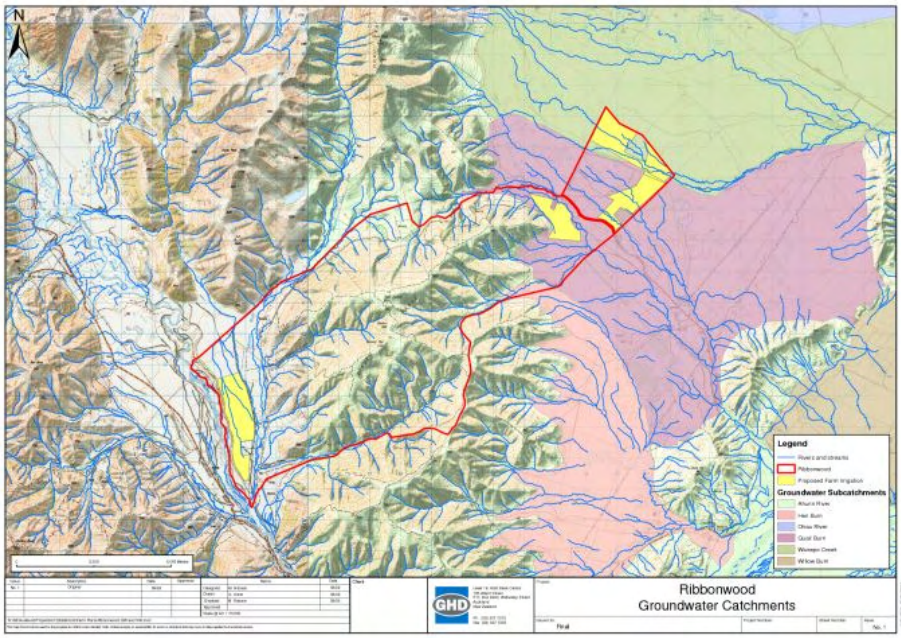
The average annual rainfall measured at the Ribbonwood Homestead is 450mm. It is acknowledged that rainfall is subject to quite substantial variation for the property is located on the fringe of the area which can receive rainfall from the northwest during summer months. This pattern appears to be a 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.



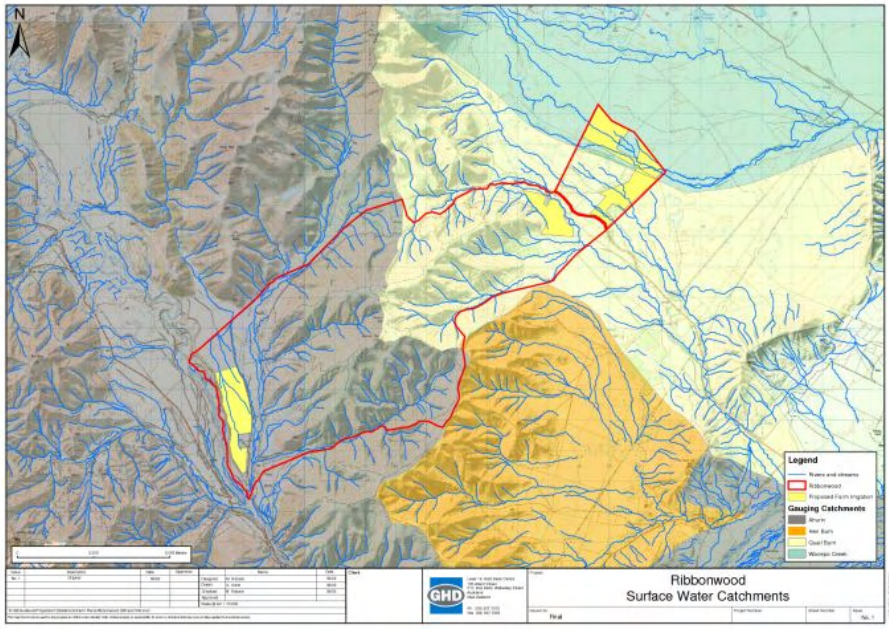
Map B: Rainfall Map

3. Environmental Context

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



Map C: Groundwater Receiving Environment



Map D: 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.

Table 3: Water Quality Study mitigation requirements for Ribbonwood

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. Upon further investigation it has been noticed within the WQS that the thresholds for Ribbonwood have been based on 650ha of irrigation land rather than the 532ha applied for. It has also been notified that the thresholds have not been determined based on the usual most stringent mitigation requirements, if this was the case then the N and P thresholds should have been 18673 kg N per annum and 648 kg P per annum. Further clarification of the establishment of thresholds has been requested from MWRL.

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.

The Wairepo and Serpentine Creeks are small shallow, stony bottomed creeks running through the proposed irrigation area.

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 4. 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 16,533kg N/year and 438 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 outside the initial thresholds set by the WQS.

Management or mitigation strategies that have been modelled in Overseer are detailed in Section 5.

Table 5: 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 needs + buffer	19,595	846
OVERSEER® outputs	17,895	773

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

The Farm Environmental Risk Assessment FERA has been undertaken on the existing farming system at Ribbonwood and has highlighted potential soil, stock and water risks. These risks are described below. The full FERA is attached as Appendix A.

The FERA focused on the irrigation areas; existing or proposed and any intensively farmed areas in the farming system.

4.3.1 Soil Risk

The risks associated with soil are that although wind erosion wasn't evident there is a potential vulnerability to wind erosion. The establishment of irrigation will ensure improved ground cover levels which will reduce the risks associated with bare ground and wind erosion.

4.3.2 Stock and water risks

The risk associated with water is that stock are not restricted from entering any of the many small waterways that flow within the proposed irrigation area.

4.3.4 Site specific management measures and existing mitigation measures in place

1. All of the crossings over creeks within the proposed irrigation area have culverts or bridges for stock and vehicle access.

Photo C: Bridge across the Serpentine Creek within the proposed irrigation area, one of many bridges over creeks

2. Fodder crops are grown as past of the pasture renewal process, ensuring that organic matter levels are not depleted in only a few paddocks. Some paddocks will have two years of crop before being put back into permanent pasture. Regrassing or reestablishment of crop after winter grazed fodder crops will be at the earliest opportunity.
3. A contractor or approved handler if required is used to apply chemicals on the farm
4. Cultivation and Trafficking

Direct drilling is the primary method of establishing pasture. Inversion tillage is used if required to break in (cultivate for the first time) any new pastures and occasionally soil can be left bare over winter. Inversion tillage is used at the most appropriate time to reduce the potential effects of wind erosion.

Stock are grazed over winter and trafficking of soils when wet does occur. Annual monitoring and identification of soil compaction and documented remedial actions taken will ensure any soil compaction due to stock grazing over winter is identified.

5. Compaction

Soil around water troughs is not compacted nor does pugging occur at present. If compaction does occur then this will be assessed during the annual soil compaction survey and remedial action taken if required.

6. Runoff

There is no evidence of track runoff directly entering a watercourse. This will be monitored as part of the annual track survey. Annual monitoring and identification of track runoff and documented remedial actions taken will ensure any track runoff entering a watercourse is identified.

4.3.5 General issues on extensive high country farming systems

In extensive high country farming systems there are a number of issues that on more intensive farming systems would be assessed as being a risk to water quality but on extensive high country farming systems they have not been defined as a risk due to the extensive nature of the farming systems and the lower stocking rate per hectare. Some of these general issues have been identified below:

1. There will be areas within the farming system where tracks will cross waterways; these are tracks that are used irregularly, in extensive areas of the farm.
2. There are also areas within a high country farming system where stock will have unrestricted access to streams for crossings and stock water. This is essential access for stock movement and stock water. On most farms there are a number of small creeks/streams that flow within the hill country and it would be logistically impossible to place stock crossings on all of these. There is also the need for stock to move across streams/creeks within a block (paddock) for grazing access. A reticulated water system would be unsustainable in the hill country as troughs would freeze solid in the winter months, preventing access to fresh drinking water.
3. Swamps/heavy grounds are an integral area in a high country farming system; they provide a water source and good grazing for stock in dry years. In undertaking the FERA it has been identified that all swamps/heavy ground need to be monitored to ensure that bank erosion, compaction and pugging does not occur.
4. Wind erosion is a significant issue in the upper Waitaki Catchment. The sparse vegetation on large areas of land in the Mackenzie Basin gives little protection to the shallow, friable soils which continue to be eroded by frost heave and westerly winds. A mean soil loss of 0.22 mm/year or 2.2 tonnes of soil lost per across a number of sites within the Mackenzie Basin has been reported. While it cannot be assumed from this information that erosion rates will continued at this level in the future, the results do confirm a strong relationship between the percentage of vegetation cover and erosion risk. The problem of bare ground and exposure to wind erosion has been compounded since the early 1990s by the rapid spread of hieracium particularly on the poorest soils. One of the most significant impacts of further irrigation in this area would be a reduction in the amount of bare ground and corresponding reduction in wind erosion risk. (***Environmental, Economic and social impacts of irrigation in the Mackenzie Basin.Ministry for the Environment, February 2005.)***
5. Monitoring and identification of any problems arising for the above three issues has been included in Table 8

5. Farm Environmental Management Plan for Ribbonwood 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.**

Table 6 indicates in brief how the measures are to be monitored and audited.

Table 6. 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 on the irrigated area	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
2	Olsen P of below 30 maintained	Regular soil testing (every 3 years)	Submission of soil tests
3	20 metre layback from any water way when applying fertliser by land based application e.g. bulk spreader	Field records	Annual Audit report
3	Restrict stock access (if land is to be utilised for grazing) via temporary fencing	Surface water testing of race/waterway as it exits	Annual auditing report for water quality testing. Photos once mitigation

FEMP stage	Measure	Monitoring	Auditing
	to permanently flowing waterways within the proposed irrigation area near the homesteads, Wairepo Creek, Serpentine Creek and the creek locally known as the North branch Serpentine Creek (see Map E)	the property	completed.
3	Construct a basic settling basin at all points of discharge from stock water races to the East Ahuriri River(see map F)	Photos and location plan	Annual audit report once settling basins completed
3	Construct a basic settling basin when the Wairepo, Serpentine and North Branch Serpentine creeks converge prior to exiting the property (see map E)	Photos and location plan	Annual audit report once settling basins completed
3	Restrict stock access, stock type and stock number from all permanently flowing waterways within other non irrigated intensively farmed areas	Location Plan and details	Location plan first annual audit

Map E: Approximate locations of mitigation measures to be undertaken at the Wairepo irrigation area

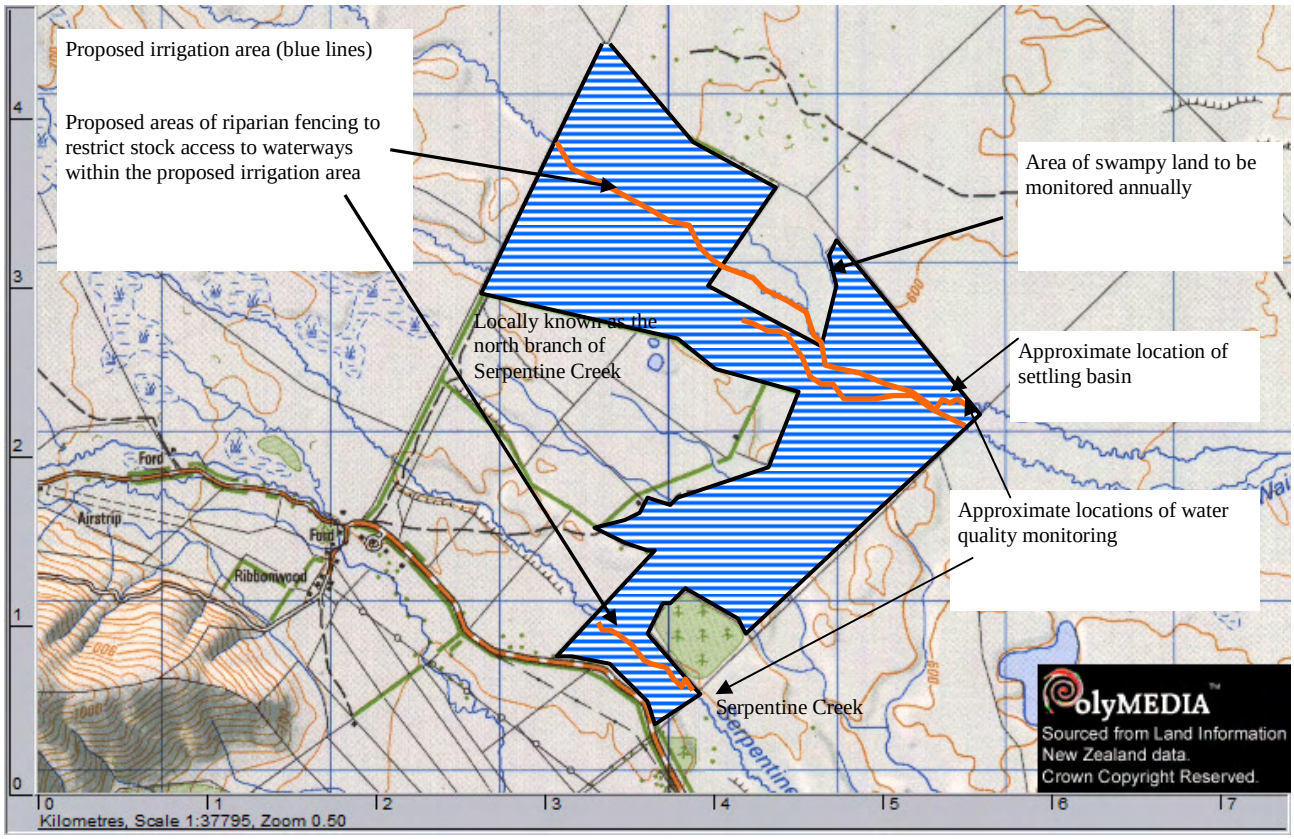


Photo D: Wairepo Creek flowing through some of the proposed irrigation area, this si to be fenced to restrict stock access

Map F: Approximate locations of mitigation measures to be undertaken at the East Ahuriri

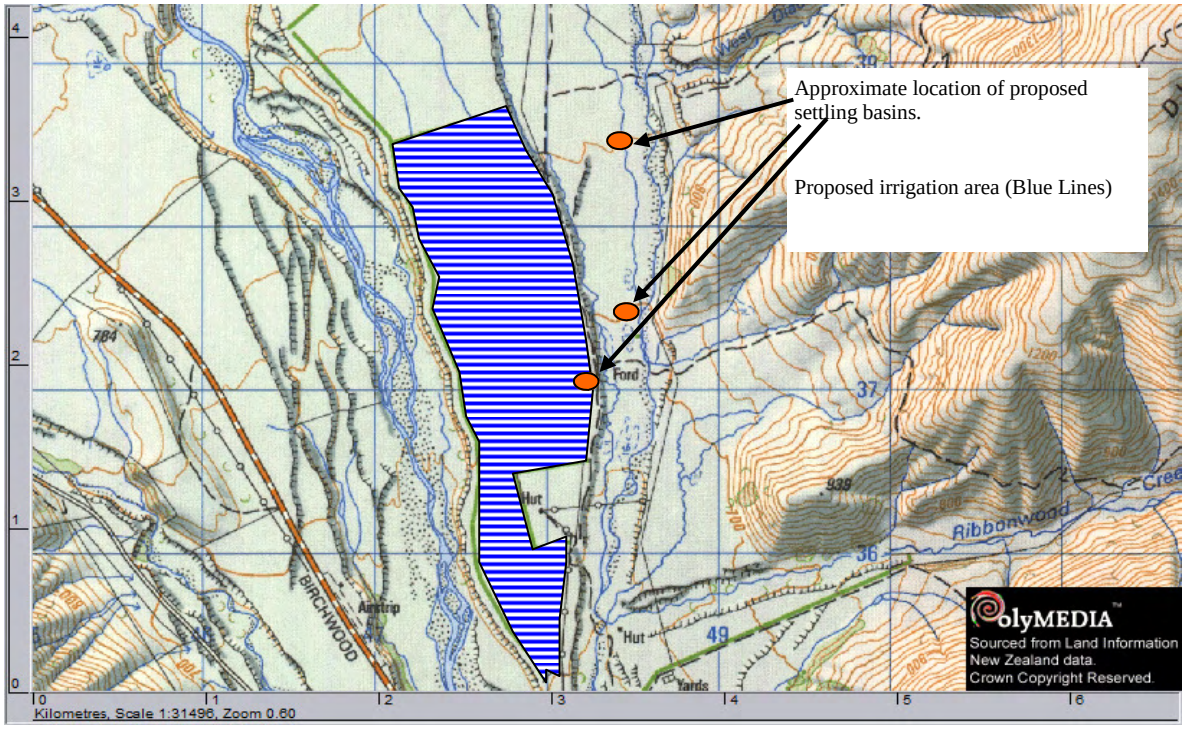


Photo E: One of the water races that flow within the proposed irrigation area at the East Ahuriri

5.2 Monitoring and Auditing

5.2.1 Baseline monitoring

Baseline monitoring is already underway on Ribbonwood Station.

Baseline water quality monitoring has been undertaken on the Serpentine and Quailburn Streams at Ribbonwood by the Upper Waitaki Water Quality Trust in 2007 and 2008.

Table 7. Baseline monitoring on Ribbonwood Station

		Location	Frequency	Measured parameters to include
Soil	Soil nutrient testing	all intensive areas in rotation	1 in 2 years	Standard suite of soil nutrients
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 current monitoring undertaken on Ribbonwood and Table 8 below shows proposed monitoring plan, frequency, location for the monitoring and parameters for the monitoring along with the triggers and contingency plans if the triggers are exceeded.

Table 8. 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 irrigation paddocks and intensive	1 in 3 years for soil nutrient status	Standard suite of soil nutrients	Olsen P >30	Reduce or stop the application of P fertiliser to the area and monitor

		Location	Frequency	Measured parameters to include	Triggers	Contingency plan if triggers are exceeded
		areas in rotation				
Soil	Soil compaction testing	All irrigation blocks in rotation	Annually for soil compaction testing.	Soil compaction	Compaction, surface capping	Remove compaction with the appropriate tool
Soil	Visually monitor Swamp area (see Map E for approximate location)	Any swamps/heavy ground	Annually	Visual compaction, pugging or stock induced bank erosion	Any visual sign of compaction, pugging or stock induced bank erosion	Remove stock from the area, assess and rectify
Runoff	Wet weather survey	All blocks	Annually	Runoff	Runoff occurring	Introduce runoff removal infrastructure where appropriate.
Water	Surface water quality	As per consent conditions	As per consent conditions	As per consent conditions	No significant decrease in water quality	If comparative surface water analysis indicates a decrease in surface water quality then the particular contaminant should be identified while a full root cause analysis is undertaken
Water	Irrigation application	Irrigation area	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
Tracks that cross waterways	Visual assessment of bank/track erosion	All tracks that cross creek/stream within extensively farmed areas	Annually	Visual assessment of bank/stream erosion caused by vehicle crossing or stock	Any sign of extensive visual erosion	Restrict vehicle and stock access until an assessment of the damage and cause can be made
Fertiliser	Fertiliser application	All Farm	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
Weed and pest pressures	Weed and pest populations	Relevant blocks	Annually	% or magnitude of infestation	ECAN monitor and communicate if their triggers have been exceeded	Legislative compliance with notice of direction issued by ECAN

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 9 below shows an example of an annual audit report for Ribbonwood Station.

Table 9. Table showing proposed contents of an annual audit report for Ribbonwood Station

Mitigation Measure	Audit Measures	Action in case of 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.
	Submission and brief interpretation of water quality analysis	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 and brief of annual wet weather survey	Any remedial actions proposed after the annual survey should be undertaken.
	Submission and brief of annual tracks that cross waterways survey	Any remedial actions proposed after the annual survey should be undertaken
	Submission and brief of annual compaction survey of the irrigation area	Any remedial actions proposed after the annual survey should be undertaken
	Annual pest and weed survey undertaken by Ecan should be submitted	Legislative compliance
Even irrigation application	Calibrate and optimise irrigators annually in house and every 5 years by an external auditor	Submission of testing and calibration

Record crop, cultivation, nutrient inputs and yields per farm management unit	Verification of records	If records have not been produced then this should be rectified for next audit
Good design of irrigation systems by a certified professional and audited every 5 years	Irrigation system audited by a certified auditor every 5 years and any changes recommended should be implemented	If changes recommended not implemented then this should be rectified by next audit
Robust irrigation scheduling	Verification of records	If records not received then this should be rectified by next audit
No June/July application of fertiliser on the irrigated area	Field records	If records not received this should be rectified for next audit.
N fertiliser applications split to under 50 kg N/application	Field records	If records not received this should be rectified for next audit
No P fertiliser within three weeks of irrigation	Field records	If records not received this should be rectified for next audit
Olsen P of below 30 maintained	Submission and brief interpretation of soil test results	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.
Install a culvert in the watercourse at Glenburn where the main track crosses the water course	Photo once installed	Timeline for completion required, if not completed prior to indicated timeframe then should be rectified by next audit
Development of settling pond at Clark Creek, just prior to crossing SHWY 8, (see Photo C and Map F)	Check settling pond is present. Photos	Areas of fencing damage should be repaired.
20 metre layback from any water way when applying fertliser by land based application e.g. bulk spreader	Field records and maps	If maps not received with annual audit this should be rectified by the next audit.
Fencing stock out of permanently flowing waterways namely Clark Creek through riparian fencing within the irrigated area at Otamatapaio	Check fenced areas are present. Photos	Areas of fencing damage should be repaired.
If redevelopment of the irrigation system at Otamatapaio is to occur alongside the banks of the Otamatapaio River then stock should be fenced out of the river and a 25m setback established	Check fenced areas are present and where they have indicated they will be. Photos	Areas of fencing damage should be repaired.
Minimum of 15m setback from new irrigation development at Glenburn and the Glenburn Swamp.	Check setback area is present. Photos	Areas of fencing damage should be repaired.
Fencing 50 metres from Lake Benmore if the proposed new irrigation development occurs at Glenburn and Otamatapaio	Check fenced area is present. Photos	Areas of fencing damage should be repaired.
20 metre layback from any water way when applying fertliser by land based application e.g. bulk spreader	Field records and maps	If maps not received with annual audit this should be rectified by the next audit.
Restrict stock access (if land is to be utilised for grazing) via temporary fencing to permanently flowing waterways within the proposed irrigation area near the homesteads, Wairepo Creek, Serpentine Creek and the creek locally known as the North branch Serpentine Creek (see Map E)	Check fenced areas are present if land is being utilised for stock grazing. Photos	Areas of fencing damage should be repaired.
Construct a basic settling basin at all points of discharge from stock water races to the East Ahuriri River(see map F)	Check settling pond is present. Photos	Settling ponds should be constructed and in use before next audit

Construct a basic settling basin when the Wairepo, Serpentine and North Branch Serpentine creeks converge prior to exiting the property (see map E)	Check settling pond is present. Photos	Settling ponds should be constructed and in use before next audit

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 MWRL Water Quality Study, and to set out the process for identification of farm specific environmental risks that arise from the inherent characteristics of the farm and from the proposed farm system and its management.

The WQS thresholds and modelled outputs from OVERSEER detailed in Section 4.2 illustrate that this proposed system meets the WQS thresholds identified.

A full on-farm risk assessment was completed in December 2009 with a commitment to address the risks identified. Section 4.3 sets out the risks identified for this property and those issues common to all high country farming systems, along with existing mitigation measures.

The mitigation and management measures detailed in Table 6 set out the measures that have been adopted to mitigate and manage the risks that were identified in the risk assessment along with mandatory good agricultural practices and those measures that have been modelled in OVERSEER.

Baseline monitoring and any additional monitoring proposed for this property are identified and set out in Section 5.2, Tables 7 and 8 allows 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.

The auditing of this plan, addressed in Section 5.2.3, Table 9 ensures that the relevant mitigation measures outlined in Table 6 are audited annually either internally or externally and communicated to ECAN by the end of July each year.

7. References

Ministry for the Environment. 2005. Environmental, Economic and social impacts of irrigation in the Mackenzie Basin.

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

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

APPENDIX A: Farm Environmental Risk Assessment

GUIDELINES QUESTIONS FOR THE
COMPLETION OF A FERA November/December 2009

The plan is to focus on those existing/proposed irrigation areas along with any intensive areas surrounding. We also need to keep in mind that this is a whole farm environmental risk assessment and hence other areas of the farm may also be applicable at times. Take notes on wetland areas, swamps, major streams/rivers, location of the yards in relation to watercourses

Some guideline questions for track management and runoff		**Notes/description**
1	Do any regularly used tracks run through streams?	No, bridges or culverts have been installed, see photos. In extensive high country properties there are areas within the farm where tracks will cross streams, these will be tracks that are used irregularly
2	Do any tracks directly runoff to a water course	NO
3	Stock crossings?	Bridges or culverts installed, see photos. In extensive high country properties there are areas within the farm where stock will cross streams and use streams for stock water.
4	Any evidence of previous runoff, soil wash or erosion?	No but a potential vunerability to wind erosion and in some areas poor ground cover.
6	Do you have a silage pit located near a permanent watercourse?	No - approximately 50m away. Silage bund
Some guideline questions for stock management		
1	Are measures taken to control dietary intakes of N and P? (Intensive beef and dairy)	N/A
2	Are stock restricted from entering watercourses in intensively farmed areas?	NO - most waterways within proposed irrigation area are not fenced
3	Do you graze stock in paddocks that have a hydraulic connection to a watercourse in winter months?	No

4	Yards - do you use water? If yes, details (e.g is it collected, discharged, what is it used for…?)	Occasional shower dip, little or no runoff
Some guideline questions for biodiversity		
1	Are there any special areas or species of interest or conservation on the farm?	No
2	Are there any water or wetland features on the farm?	no wetland - water features, swampish area, many creeks
3	Are these features actively protected?	No
Some guideline questions for chemical usage	***Chemical storage and handling is dealt with under the Hazardous Substances and New Organisms Act***	
1	Are those handling chemicals of 'approved handler status'?	Yes - contractor for spraying
Some guideline questions for water		
1	Do you use border dyke irrigation?	NO
2	Do you collect wipeoff losses?	N/A
3	Are these wipeoff losses discharged to a watercourse	N/A
4	Is there evidence of bankside erosion in any permanent flowing watercourses?	Small amount in some, not at the risk level as yet, primarily within the proposed irrigation area - small shallow rocky bottomed streams
Some example questions on cropping		
1	Is inversion tillage used? Describe	Yes if required, primarily direct drilled
2	Are soils left bare over winter?	No
3	If arable or fodder crops are grown, are measures taken to conserve or build soil organic matter on arable land?	Yes - turnips/grass grown double cropped and then into permanent pasture

4	Are remedial measures in place after winter grazed crops?	Yes - sown into grass at earliest opportunity
5	Is there a possibility of run off from winter grazed areas reaching a water course?	No
6	Other cropping issues or incidences? Please describe	No
Some example questions on soil health		
1	Are there compacted, consolidated or capped soils?	None evident
Some example questions on pest and weed management		
1	Do you undertake any current pest or weed control? E.g rabbits, gorse	Shoot rabbits and potentially poison, most of the boundary within the intensive area is rabbit fenced