Farm Environmental Management Plan: Otamatapaio Station, Omarama.

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

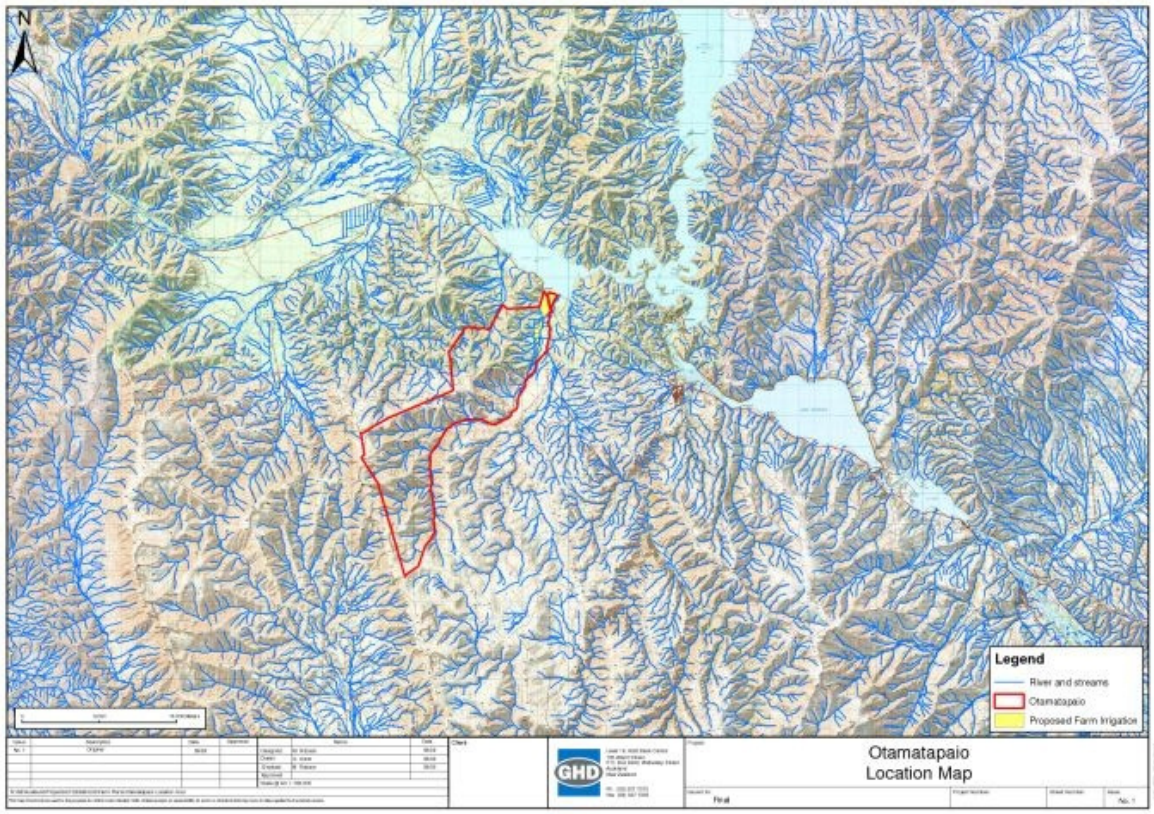
Otamatapaio (5568 ha's) and Glenburn (1164 ha's) are two freehold properties run in conjunction by the company Otamatapaio Station Ltd.

Otamatapaio is positioned 12 km from Omarama, 10 km from Otematata, on State Highway 83, boundarying Lake Benmore eastern arm, which is a popular summer holiday area.

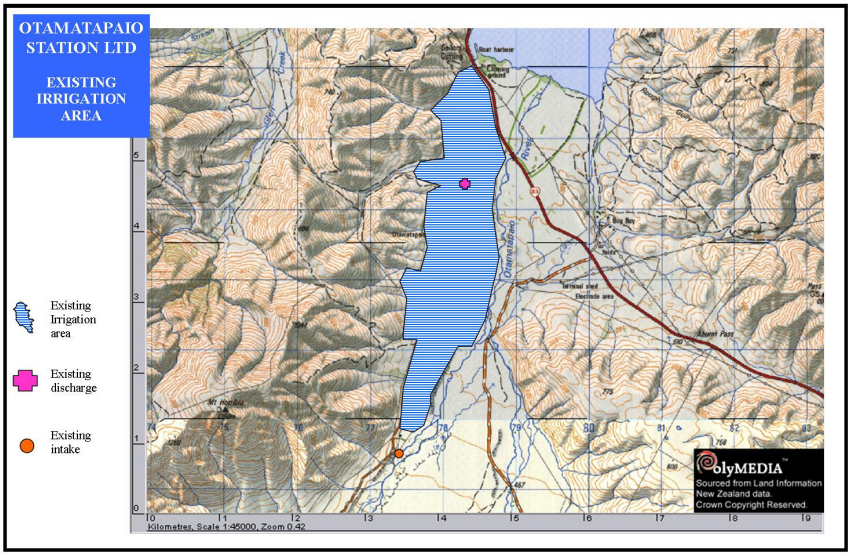
The property is well balanced, from High country extensive grazing area to intensive irrigated pastures, swamp areas and low lying dryland fans.

It is well positioned with some of the extensive country receiving southerly rains, most rain generally from the nor-west.

Under current management the property is running 12,000 stock units comprising of fine merino sheep and beef cattle.



Map A: Location map



Map B: Existing irrigation area

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: Mixed aged	Over sown mid Altitude country	Wean Feb: Summer grazing native high altitude country	April mustered off native, mid altitude high country	Supplement fed on lower paddocks, (property has high snow risk)
Older Ewes & 2ths	Lamb on swamp areas & dryland paddocks	Irrigation/swamp: Wean Feb.	Dryland Country	Irrigation
Wethers	Utilised to maintain growth lanes etc, used as management tool	Mid Dec: High Altitude country	Apr/May: Grazing mid altitude	Mid Altitude
Lambs/Hoggets	Irrigation	Weaned February: irrigation, dryland paddocks	Wether hoggets, hill country, ewe hoggets, irrigation/dryland paddocks	Irrigation
R2 Heifers	Calving Irrigation	Irrigation/Hill country	Hill country	Hill country

R2 Steers	Irrigation	Irrigation		
R1 Steers	Cows Calve mid October Hill country	On cows	On Cows	Irrigation
R1 Heifers	Cows Calve mid October Hill country	On cows	On cows	Irrigation
Bulls	Paddocks	Out with cows	Paddocks	Paddocks

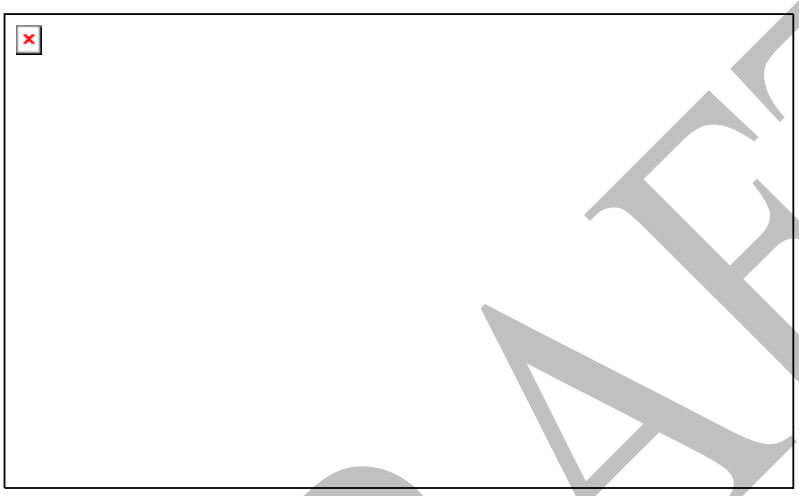


Photo A: Existing irrigation at Otamatapaio

2.2 Proposed Farming system with new irrigation areas:

Current irrigated area = approx 150 ha comprising of: 76 ha pivot

20 ha modern borders

40 ha old border system/wild flooding

Proposed redeveloped irrigation area would be 200 ha's, all spray irrigation.

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: Mixed Age	Over sown mid Altitude country	Wean Feb: Summer grazing native high altitude country	April mustered off native, mid altitude high country	Supplement fed on lower paddocks, (property has high snow risk)
Older ewes & 2ths	Lamb on swamp areas & dryland paddocks	Irrigation/swamp: Wean Feb.	Dryland country	Irrigation/Swamp

Wethers	Utilised to maintain growth lanes etc, used as management tool	Mid Dec: High Altitude country	Apr/May: Grazing mid altitude	Mid Altitude
Lambs/Hoggets	Irrigation	Weaned February: irrigation, dryland paddocks	Wether hoggets, hill country, ewe hoggets, irrigation/dryland paddocks	Irrigation
Cows	Calving: Hill country	Spread between irrigation/swamp & hill country	Spread between irrigation/swamp & hill country	Hill country
R2 Heifers	Calving Irrigation	Irrigation/Hill country	Hill country	Hill country
R2 Steers	Irrigation	Irrigation		
R1 Steers	Cows Calve mid October Hill country	On cows	On Cows	Irrigation
R1 Heifers	Cows Calve mid October Hill country	On cows	On cows	Irrigation
Bulls	Paddocks	Out with cows	Paddocks	Paddocks

2.3 Soils

Otamatapaio:

- The flats and fan terraces comprise of Grampian soil, fine sandy loam, medium to high fertility.
- Heavier Swampy flats are Dobson soils
- Lower tussock mid/higher tussock a mix of Waitaki, Omarama Benmore and Puketeraki soils.
- Higher altitude are Kaikouras silt and stony loams

Glenburn:

- Lighter flats Mackenzie shallow stony silt loams
- Swamp Dobson soils, high fertility
- Easy rolling hill country comprising of Grampian soils.

2.4 Topography

Otamatapaio/Glenburn ranges from approx 360 metres, Lake Benmore to 1370 metres at the highest point on the Hawkdun range.

Otamatapaio has a mix of west/east aspect while the flats are not influenced by aspect.

Property varies from extensive high country to rolling lowlands, down to alluvial fans that run into Lake Benmore, which are developed and subdivided into more intensely farmed areas.

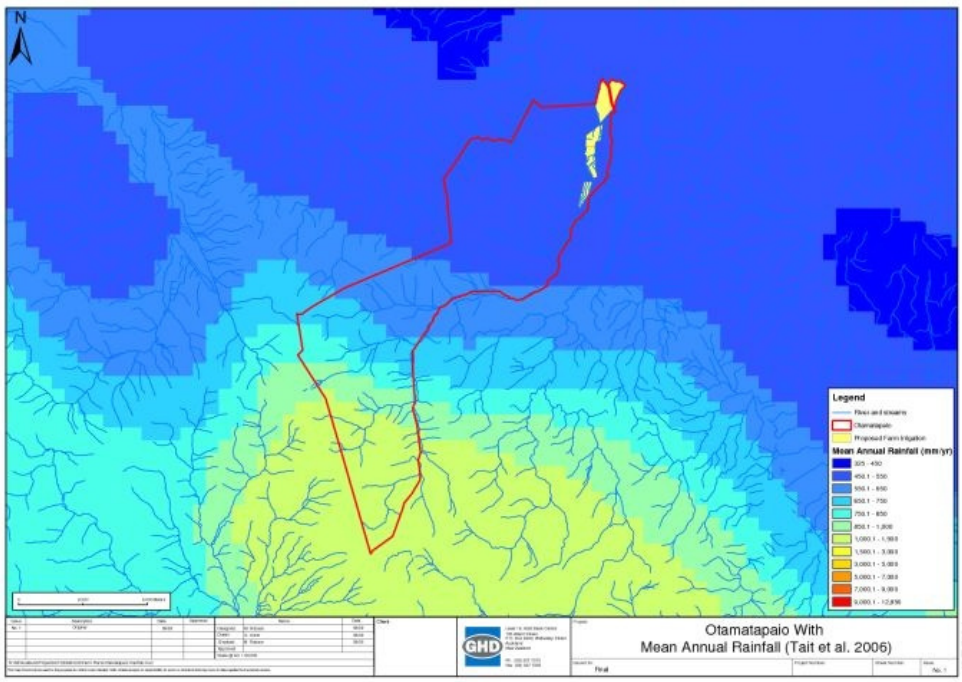
Generally the property has an excellent balance of winter/summer country greatly enhanced by its irrigated flats.

2.5 Climate

Rainfall varies annually from 350 mm/380mm on the front country (Glenburn) with a higher rainfall on the Otamatapaio alpine catchment which varies annually from 450mm to 500mm.

The property is exposed to strong northerly winds which bring hot dry summer conditions, but also brings northerly rains. Otamatapaio is often subjected to cold southerly conditions, which also brings in rain.

Otamatapaio can receive severe snow storms, three to four per annum with a 1 year in five severe snow, which can make the winter very long and cold, with heavy frosts.



Map C: Mean Annual rainfall data.

3. Environmental Context

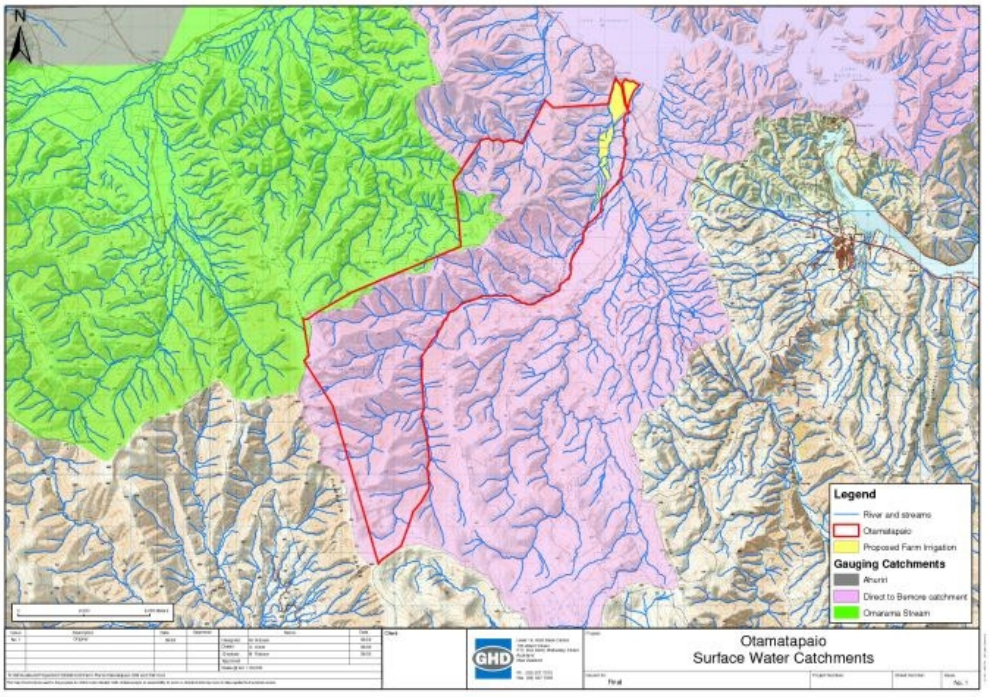
The environmental context of the farm is a reference both to local and wider receiving environments.

3.1 Water Quality Study receiving environments and mitigation requirements

Otamatapaio Station, according to the WQS, lies in the direct to Lake Benmore surface water catchments, with a small area of Omarama Stream surface water catchment.

Table 3 shows the calculated nutrient mitigation requirement of the receiving environments determined in the WQS and the resulting thresholds for N and P for Otamatapaio Station.

For this farm, the Lake Benmore mitigation requirements are the most stringent. These mitigation requirements cap Otamatapaio Station's nutrient discharges at 22466 kg N per annum and 588 kg P per annum.



Map D: Surface Water receiving environment

3.2 Local receiving environments

Photo B: Clarkes Creek: Area on left developed into Riparian Margin

Photo C: Local receiving environment

Otamatapaio Station local catchment is Lake Benmore. The water run off areas is fed to the Lake via a heavy swamp area below the irrigation, through to Clarkes Creek catchment.

Both the swamp area and lower end of the Clarkes Creek, before it feeds into Lake Benmore can be developed in highly sustainable riparian margins to filter water before it enters into Lake Benmore.

The majority of the run-off water will have run via two riparian margins before entering Lake Benmore.

Two photos above show the local receiving environments and areas to be developed into Riparian Margins.

Table 3. Water Quality Study mitigation requirements for Otamatapaio Station

Stream mitigation required for periphyton kg/ha irrigated land		Secondary stream mitigation required for periphyton kg/ha irrigated land		Stream mitigation required for ANZECC kg/ha irrigated land		Secondary stream mitigation required for ANZECC kg/ha irrigated land		GWR mitigation required kg/ha irrigated land		Lake mitigation required kg/ha irrigated land	
N	P	N	P	N	P	N	P	N	P	N	P
										-10.70	-1.1

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 for Otamatapaio Station using the most stringent nutrient mitigation requirement are 22466 N/year and 588 kg P/year. The table below shows the output from OVERSEER for the modelled proposed farming system at Otamatapaio 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 given in Appendices B and C.

Table 5. Total N and P losses modelled by OVERSEER for the proposed farming system on Otamatapaio Station and WQS thresholds

	OVERSEER proposed modelled outputs kg/year	**WQS modelled outputs kg/year**
Total N leaching/runoff	16747	22466
Total P leaching/runoff	291	588

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

Due to insufficient time before, 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.

- Mitigating areas, i.e. Clarkes Creek
- Irrigated land adjacent to Lake Benmore
- Otamatapaio Borders, run-off
- Mitigation of the above areas via:
    - Fencing off 50 metre Lay Back from Lake Benmore
    - Riparian Development for Clarkes Creek
    - Develop Riparian strip in swamp area for runoff from Otamatapaio's current borderdykes
    - Upgrading existing irrigation into spray irrigation

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

5. Farm Environmental Management Plan for Otamatapaio Station

5.1 Mitigation measures and management options adopted on Otamatapaio Station

The table below shows the all the mitigation and management tools that are proposed to be undertaken on Otamatapaio 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 6 indicates in brief how the measures are to be monitored and audited.

Table 6. Table of mitigation options, monitoring and auditing for Otamatapaio Station

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 irrigation. Irrigation maintenance always applied early spring Oversown hill country bi annual maintenance often applied late autumn or end of winter.	Field records	Signed field records
2	N fertiliser applications split to under 50 kg N/application	Field records	Signed field records

FEMP stage	Measure	Monitoring	Auditing
2	No P fertiliser within three weeks of irrigation	Field records	Signed field records
2	Olsen P of below 30 maintained on applicable areas Some Hill country Olsen P results are naturally higher than 30	Regular soil testing (every 3 years)	Submission of soil tests
3	Redevelopment of existing irrigation, conversion to spray irrigation	Photos and location map	Annual audit report until conversion completed
3	Fencing 50 metres from Lake	Photos and location map	First annual audit report
3	Development of Riparian margins	Water Quality monitoring Field records	Annual audit report
3	20 metre layback from any water way when applying fertliser	Field records	Annual Audit report
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		

See Photos B and C for location of riparian margins, See Map B for the location of the existing irrigation

5.2 Monitoring and Auditing

5.2.1 Baseline monitoring

Baseline monitoring is already underway on Otamatapaio Station.

Table 7. Baseline monitoring on Otamatapaio

		Location	Frequency	Measured parameters to include
Soil	Soil nutrient testing	All blocks in rotation	1 in 3 years	Standard suite of soil nutrients, pH C, N and organic matter
Water	Surface water quality	Monitoring points on Map E	Monitoring undertaken in 2007 and 2008	Total Nitrogen, nitrate, ammonia, total Kjeldahl nitrogen, total phosphorus, dissolved reactive phosphorus, suspended solids.
Pasture	Ground cover and species	All blocks	Annually	% Ground cover, species
Weeds and Pest Monitoring		Whole Farm	Annually	Done as part of an annual survey from Ecan

Map E: Monitoring Points for Water Quality Otamatapaio

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 Otamatapaio Station and Table 8 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 8. Example monitoring plan for Otamatapaio 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 status	Standard suite of soil nutrients, pH C, N and organic matter	Olsen P >30	Reduce or stop the application of P fertiliser to the area and monitor
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
Runoff	Wet weather survey	All blocks	Annually	Runoff	Runoff occurring	Immediately review current runoff mitigation options for tracks. Introduce further runoff removal infrastructure where appropriate.
Water	Surface water quality	Monitoring points on Map E	3 times a year for the first 5 years and then reviewed	Total Nitrogen, nitrate, ammonia, total Kjeldahl nitrogen, total phosphorus,	No significant decrease in water quality	If comparative surface water analysis indicates a decrease in surface water quality then the

		Location	Frequency	Measured parameters to include	Triggers	Contingency plan if triggers are exceeded
				dissolved reactive phosphorus, suspended solids.		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
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
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		Done as part of an annual survey from Ecan
Complete table with other monitoring planned to include the monitoring of FEMP stage 2 measures						

See Map E for water quality monitoring points; see Map B for the area of existing irrigation

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 in Table 9. Those mitigation measures identified in FEMP stage 3, the auditing measures and actions will be completed in Table 9 once the FERA is completed.

Table 9 below shows an example of an annual audit report Otamatapaio Station

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

Audit measures	Action in the case of non-compliance
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

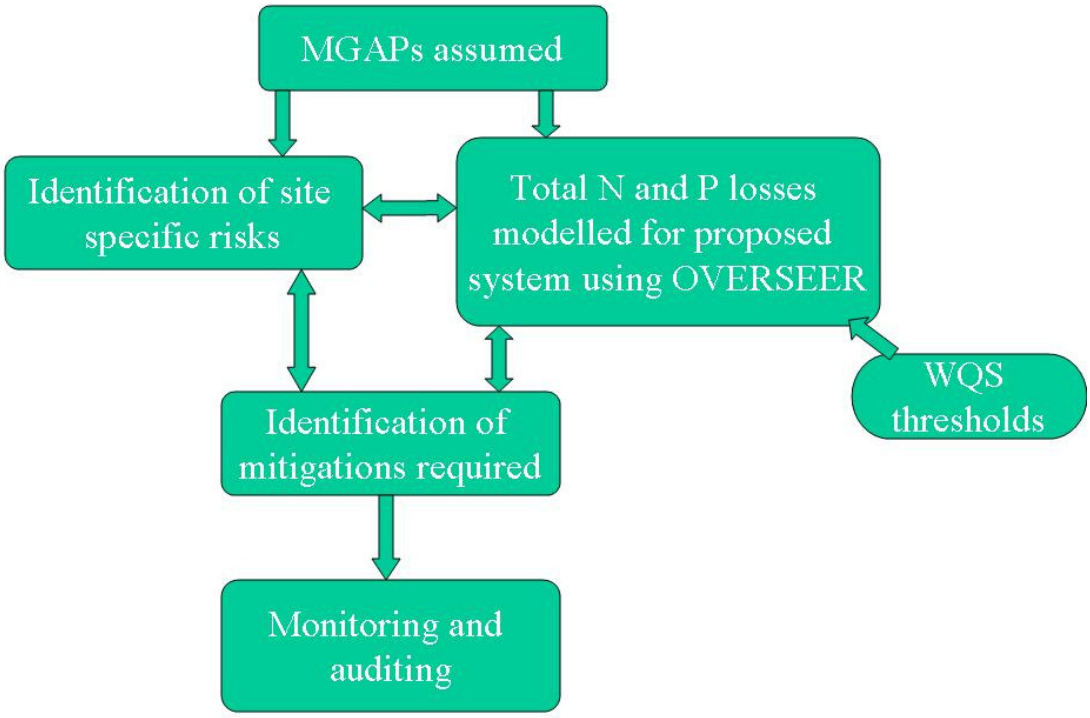
6. Summary

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 6 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.

Appendix A: Overview schematic of the process to build a Farm Environmental Management Plan



MGAP – Mandatory good agricultural practices