Farm Environmental Management Plan: Glentanner Station – Catherine Fields

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

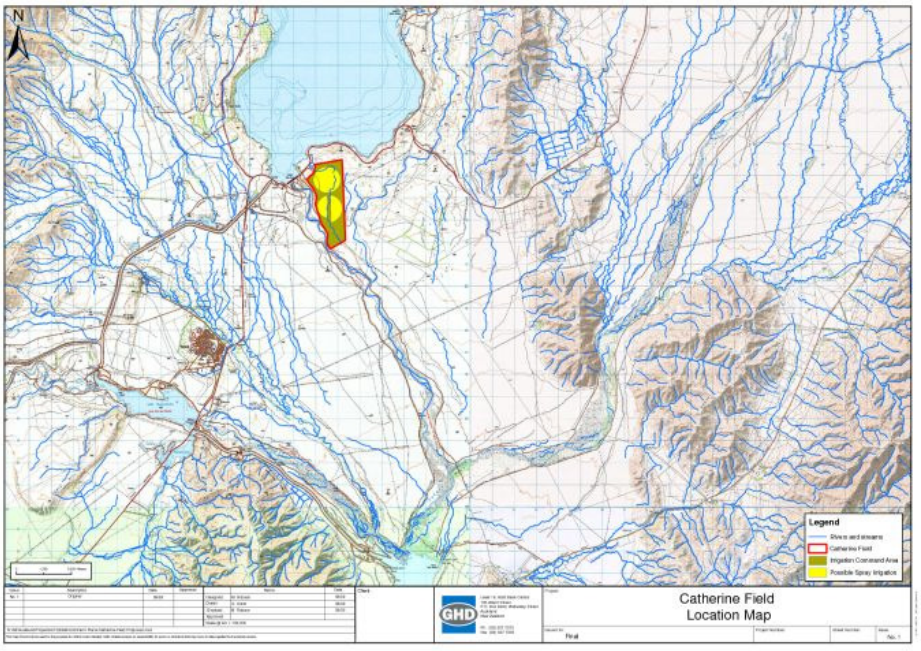
2.1 General farm description

Glentanner Station farms Catherine Fields, adjacent to State Highway 8 between Twizel and Tekapo where the proposed irrigation development is to be undertaken.

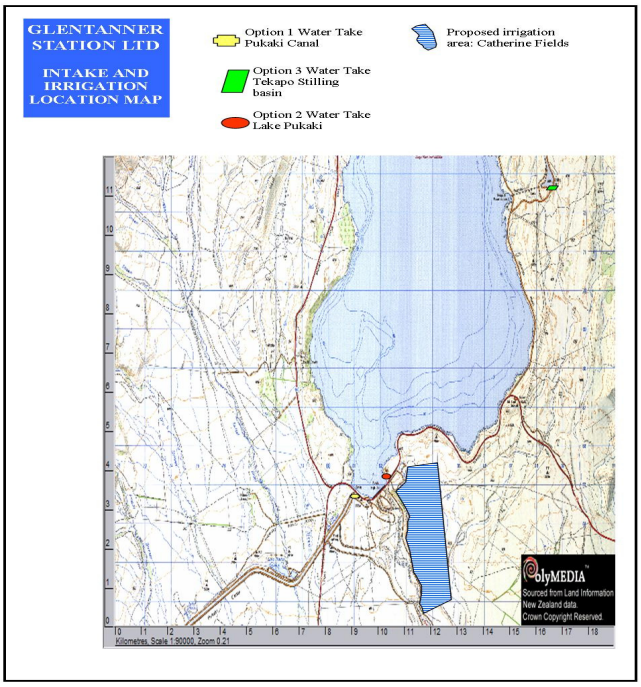
Catherine Fields is a 435ha property that is run in conjunction with Glentanner Station, a 16,000ha high country property. Both of these properties are on one title.

Collectively both Glentanner and Catherine Fields run 10,000 SU with approximate proportions of 80% being sheep, 15% beef cattle and 5% deer.

At present Catherine Fields is primarily used as a finishing farm for Glentanner and running stud merino ewes plus all of the hoggets are wintered there. All of the Glentanner annual draft ewes are sent to Catherine Fields in October, lambed there and then the ewes are sold.



Map A: Location



Map B: Proposed Irrigation development area at Catherine Fields

Photo A: Catherine Fields, winter feed crop

At present;

1. approx. 188ha has been cultivated,
2. approx 200ha has been oversown
3. approx 110ha is unimproved.
4. Glentanner owns 435ha but also leases 62ha off Department of Conservation and is likely to get ownership of this resulting in approx. 497ha

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**
330 stud ewes	Cult. paddocks	Cult. paddocks	Oversown pdks	Oversown pdks Hay/silage
400 MA sale ewes	Oversown pdks	Oversown pdks	N/A	N/A
200 stud hoggets	Cult. paddocks Greenfeed	Cult. paddocks	Cult. paddocks Green feed	Cult. paddocks Hay/Silage
400 MS hoggets **Born K Fields**	Cult. paddocks Greenfeed To GT mid Oct	Cult. paddocks	Cult. paddocks Green feed	Cult. paddocks Hay/Silage
1600 MS hoggets **Born GT**	Cult. paddocks Green feed to GT mid Oct	N/A	Cult. paddocks Green feed	Cult. paddocks Hay/Silage
800 2T ewes	N/A	N/A	Oversown pdks unimproved pdks greenfeed	Oversown pdks unimproved pdks Hay/Silage

Photo B: Catherine Fields showing the existing landcover and the visual difference between dryland and winter feed crop

2.2 Proposed farming system

For the proposed system, we have;

1. irrigated land 200ha
2. shoulder land 100 ha
3. dry land 200 ha

Total approx. 497ha

Approx. 50ha of irrigable land will be used for cropping, e.g. oats, barley, small seeds.

Breeding ewes will generally be on dryland.

Young ewe replacements and all finishing sheep will be on irrigation for most of the year.

Finishing cattle will generally be on irrigation, spring, summer and autumn, shoulder or dryland in winter with supplement.

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**
330 stud ewes	Dryland	Dryland	Shoulder irrigated	Dryland
400 MA sale ewes	Dryland	Shoulder irrigated	N/A	N/A
200 stud hoggets	irrigated	irrigated	irrigated	irrigated
400 hoggets Born K Fields	irrigated	irrigated	irrigated	irrigated
1600 hoggets Born GT	irrigated	irrigated	irrigated	irrigated
800 2T ewes	N/A	N/A	Shoulder irrigated	Shoulder dryland
320 steers	Shoulder irrigated	irrigated	irrigated	Shoulder dryland
Class of stock 1000 MA ewes	Spring Dryland	Summer Dryland	Autumn Shoulder irrigated	Winter Dryland
Crop	Irrigated	Irrigated	Irrigated	Irrigated

16 year rotation on irrigation or shoulder land.

- Ryegrass-5 years
- Spring barley followed by ryecorn (greenfeed)-1 year
- Spring oats followed by ryecorn (greenfeed)-1 year

- Lucerne-7years

- Spring barley followed by ryecorn (greenfeed)-1 year

- Spring oats followed by ryecorn (greenfeed)-1 year

- Back to Ryegrass

The dryland will be mainly oversown, but with approx. 50ha of light outwash land on a lower level adjacent to the Pukaki riverbed left unimproved.

2.3 Soils

Catherine Fields is mostly glacial morraine downs with large areas able to be cultivated on deeper soils. This whole area is part of the terminal morraine of the Tasman glacier

The area of land proposed for irrigation is predominantly Tekapo and some Maryburn soils. Tekapo Soils are generally well-drained and are considered to be shallow to deep soils. Maryburn are generally excessively to somewhat excessively drained. The PAW of the soils is within 25-85mm

2.4 Topography

Catherine Fields is mostly glacial moraine downs with large areas able to be cultivated on deeper soils. There are rocky outcrops. There is a dry watercourse in the centre of the farm which drained water from the glaciers in ancient times. This watercourse is generally rocky with shallow soils. There is land on a lower level adjacent to the Pukaki River with lighter soils, i.e. a glacial outwash area. This whole area is part of the terminal moraine of the Tasman glacier

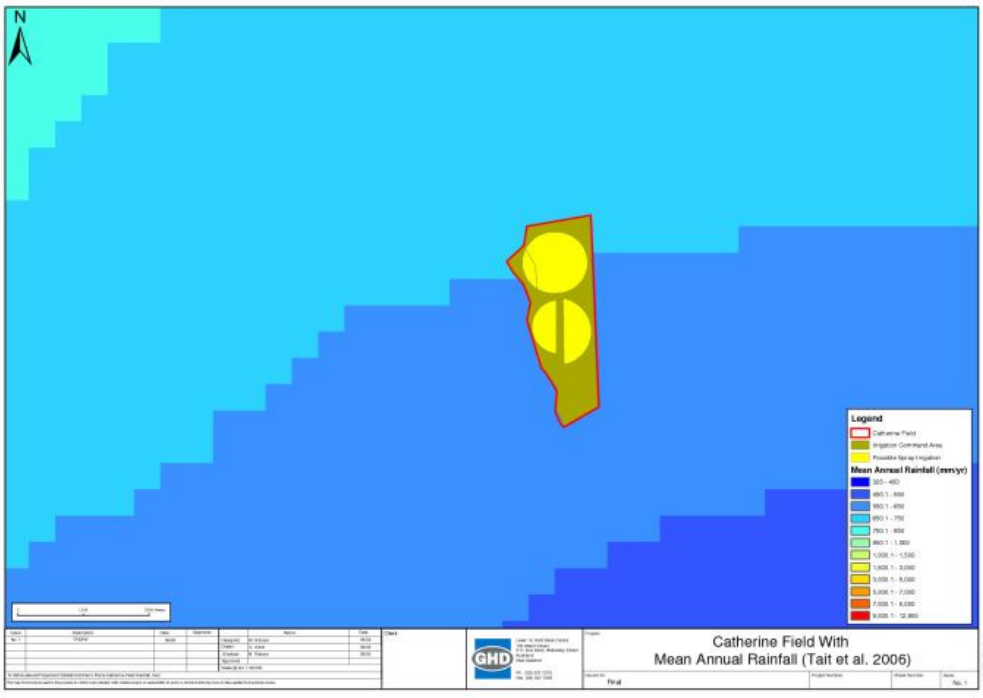
Photo C: Showing the topography.

2.5 Climate

In terms of climate Catherine Fields generally compliments Glentanner which is much closer to the main divide and has an exceptionally high rainfall. Snow and rainfall at Catherine Fields is less than at Glentanner so young sheep and higher value sheep such as stud ewes perform better commercially.

Catherine Fields experiences hot dry summers and cold winters with snowfalls up to 700mm having occurred twice in the last 20 years. The rainfall is approx. 550mm, but it is the variability of rainfall which is a large problem for pasture growth and growing an adequate supply of winter feed supplement. Paddocks shut up for hay, silage or baleage in the spring often don't deliver crops because of dry spring-early summer periods. Spring crops grown for supplement such as barley or oats often don't grow for the same reason. As a result every other year, winter supplements have to be bought in, a large added cost on top of the spray, drilling, fertiliser and seed costs of the failed spring crops.

Dry periods in February and March result in young pasture failing, particularly clovers. About every fourth year summer autumn droughts have meant that Catherine Fields has been totally destocked over the February-April period with capital stock transported 35km up to Glentanner Station. The climate variability means dryland farming at Catherine Fields is not economically sustainable for Glentanner.



Map C: Mean Annual Rainfall

3. Environmental Context

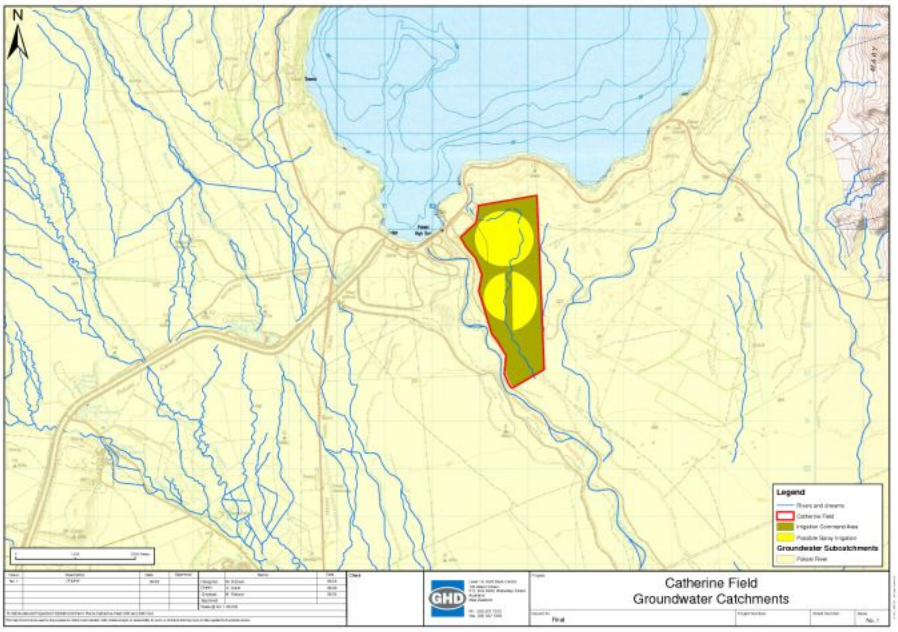
The environmental context of the farm is a reference both to local and wider receiving environments.

3.1 Water Quality Study receiving environments and mitigation requirements

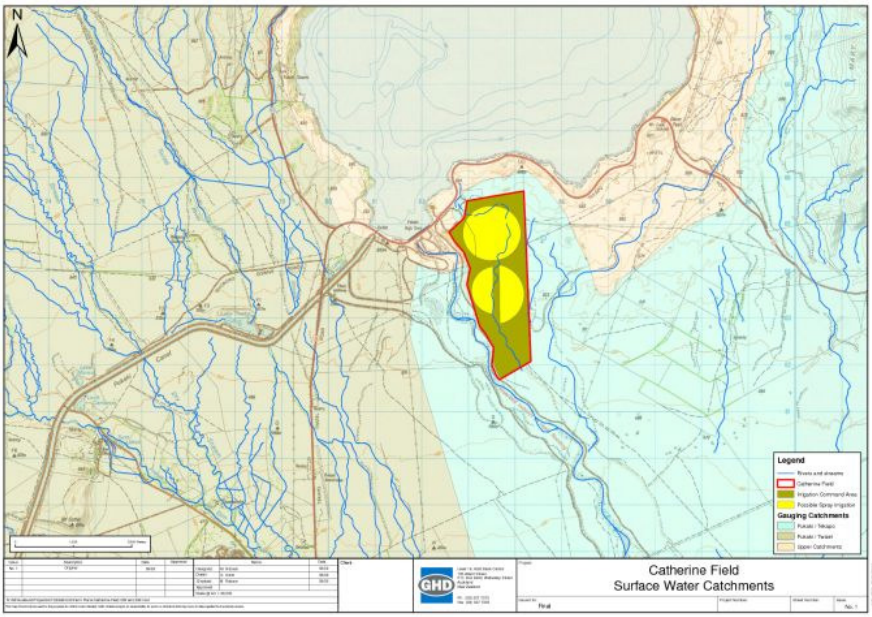
Catherine Fields, according to the WQS, lies in the Pukaki River groundwater catchment and Pukaki/Tekapo surface water catchments. These maps are shown above.

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 Catherine Fields.

For this farm, the groundwater mitigation requirements are the most stringent. These mitigation requirements cap Catherine Fields nutrient discharges at 4432 kg N per annum and 135 kg P per annum



Map D: Groundwater receiving environment



Map E: Surface Water receiving environment

3.2 Local receiving environments

The local receiving environment for Catherine Fields is the same as those referred to in the WQS; Pukaki River groundwater catchment and Pukaki/Tekapo surface water catchments.

Table 3. Water Quality Study mitigation requirements for Catherine Fields

	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
Catherine Fields									-3.10			

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 Catherine Fields, using the most stringent nutrient mitigation requirement, are 4432 kg N/year and 135 kg P/year. The table below shows the output from OVERSEER for the modelled proposed farming system at Catherine Fields. 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 outputs is included in Appendix C. *At the time of writing we are unable to attach the OVERSEER model inputs due to technical difficulties.*

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

	OVERSEER modelling outputs kg/year	**WQS threshold kg/year**
Total N leaching/runoff	2882	4432
Total P leaching/runoff	127	135

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.

a) Soil condition after winter fodder crops

b) Soil Erosion

c) Timing of N Fertiliser applications

d) Water trough placement

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

5. Farm Environmental Management Plan for Catherine Fields

5.1 Mitigation measures and management options adopted on Catherine Fields

The table below shows the all the mitigation and management tools that are proposed to be undertaken on Catherine Fields. 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 Catherine Fields

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	**e.g.** 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
2	Olsen P of below 30 maintained	Regular soil testing (every 3 years)	Submission of soil tests
3	Irrigation buffer from ephemeral water course	Photos and location map	First annual audit

FEMP stage	Measure	Monitoring	Auditing
3	Irrigation buffer from the Pukaki River of approximately 130mtrs	Photos and location map	First annual audit
	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 Catherine Fields

Table 7. Baseline monitoring on Catherine Fields

		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
Pasture	Ground cover and species	All blocks		% Ground cover, species
Weed and Pest		Whole Farm	Annually	Done as part of an annual survey from Ecan

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 Catherine Fields 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 Catherine Fields 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 blocks in rotation	1 in 3 years for soil nutrient status	Standard suite of soil nutrients, pH C, N and organic matter	Olsen P of greater than 30	Reduce or stop the addition of P fertiliser to area and monitor
Soil	Soil compaction testing	All irrigation blocks in	Annually for soil compaction	Soil compaction; surface and subsoil	Compaction, surface capping	Remove compaction with the most appropriate tool

		Location	Frequency	Measured parameters to include	Triggers	Contingency plan if triggers are exceeded
		rotation	testing.			
Runoff	Wet weather survey	All irrigation blocks	Annually	Runoff from tracks	Runoff occurring	Immediately review current runoff mitigation options for tracks. Introduce further runoff removal infrastructure where appropriate.
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		This is currently undertaken via a survey from Ecan.
Complete table with other monitoring planned to include the monitoring of FEMP stage 2 measures						

See Map B: Proposed irrigation development area for the location of the irrigation land.

Where triggers are exceeded, the immediate contingency plans in Table 8 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, 8 and 9.

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 Catherine Fields.

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

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
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

Audit measures	Action in the case of non-compliance
Auditing that must be done internally	
Self certification for application of fertiliser according to code of practice	Any failures in observing the code of practice for applying fertiliser should be rectified and followed up in the next audit
Submission of proof of 'approved handler' status	Inappropriate handling of chemicals should cease until an approved handler is in place

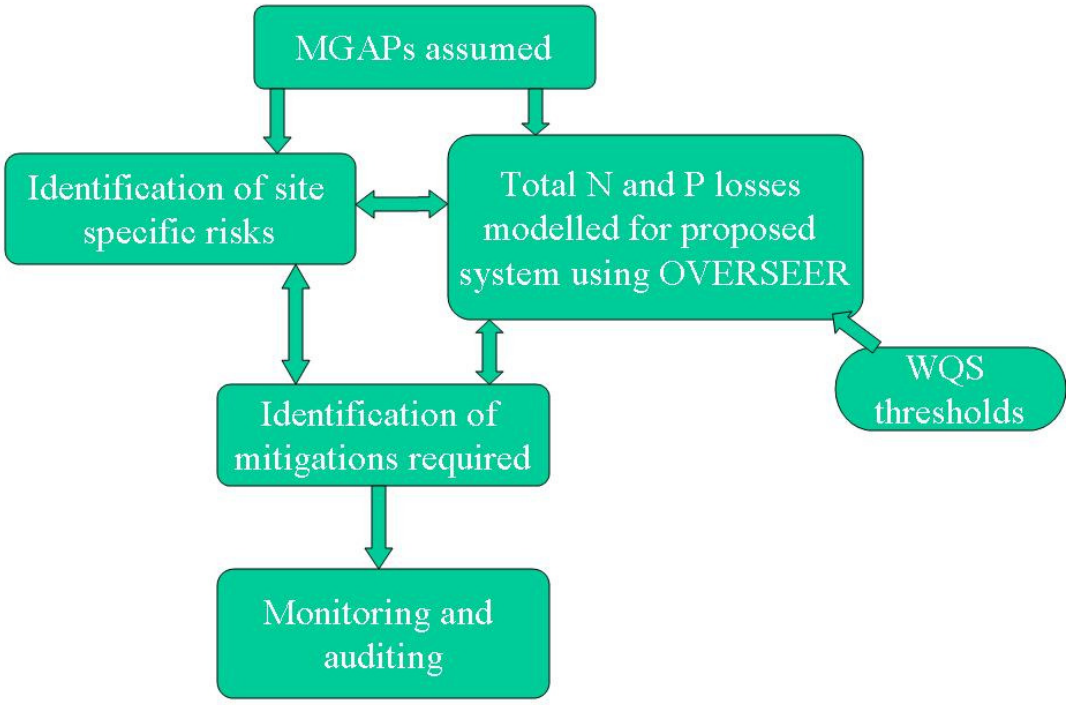
6. Summary

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