

Farm Environmental Management Plan: Glentanner Station – Catherine Fields

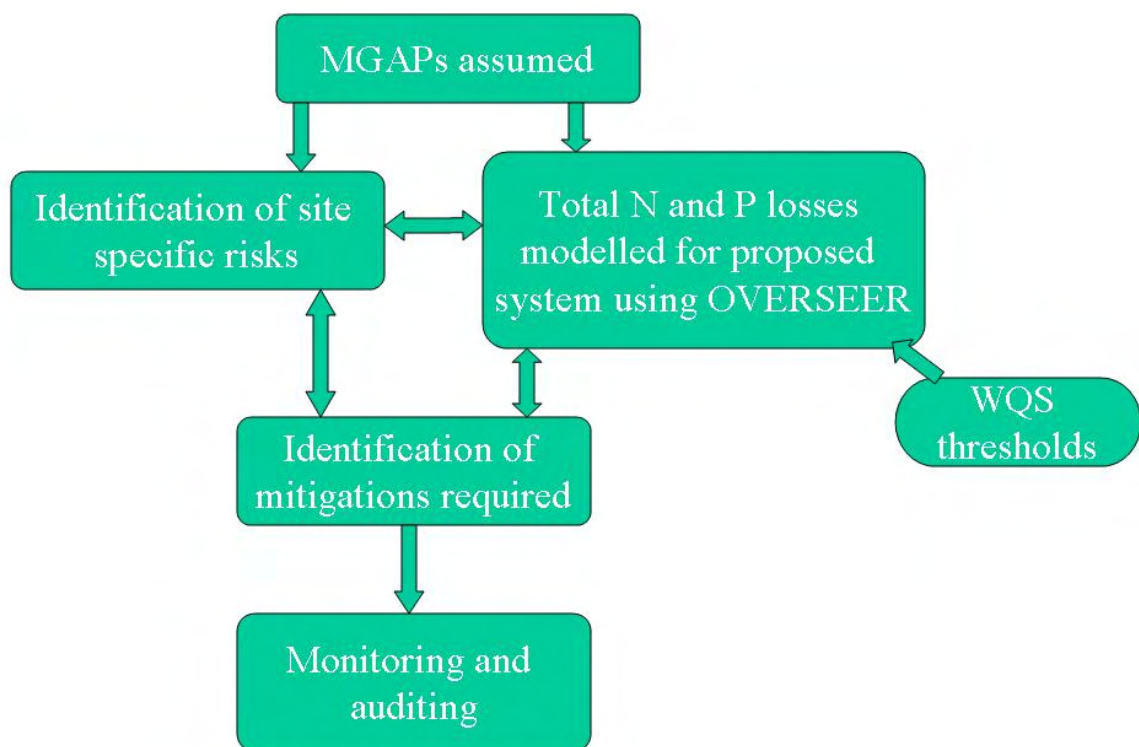
1. Introduction

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 Planning. 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

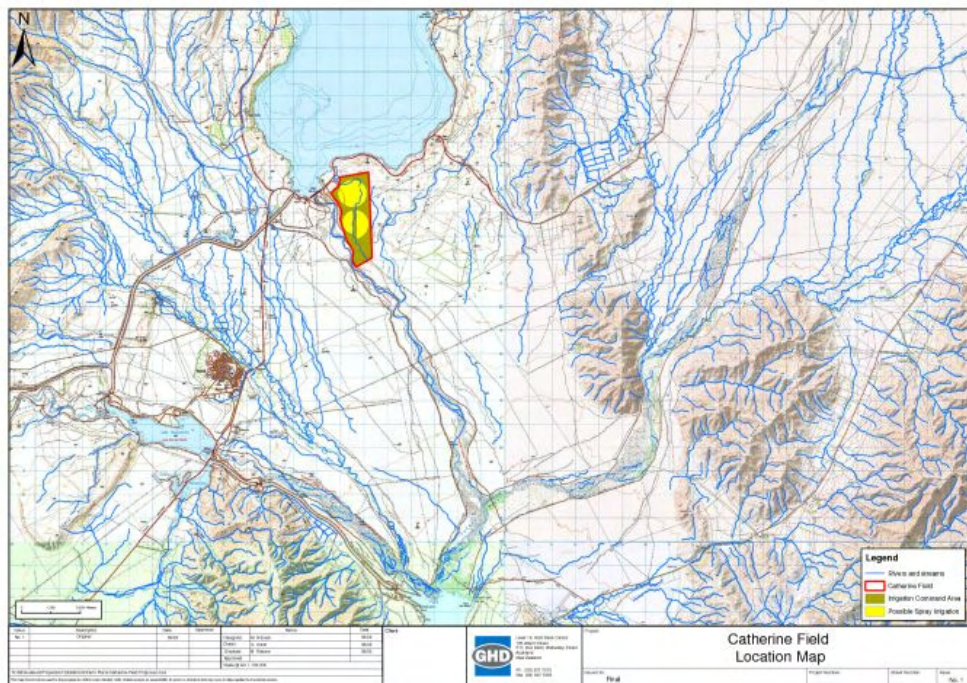
2.1 General farm description

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

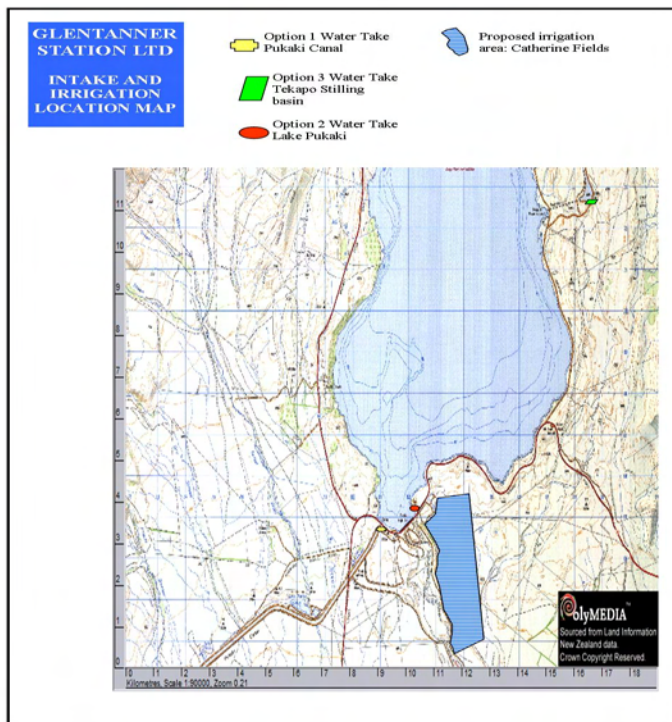
Catherine Fields is a 435ha property that is run in conjunction with Glentanner Station, a 16,000ha high country property. Both of these properties are on one title.

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, lambd 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 moraine downs with large areas able to be cultivated on deeper soils. This whole area is part of the terminal moraine 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



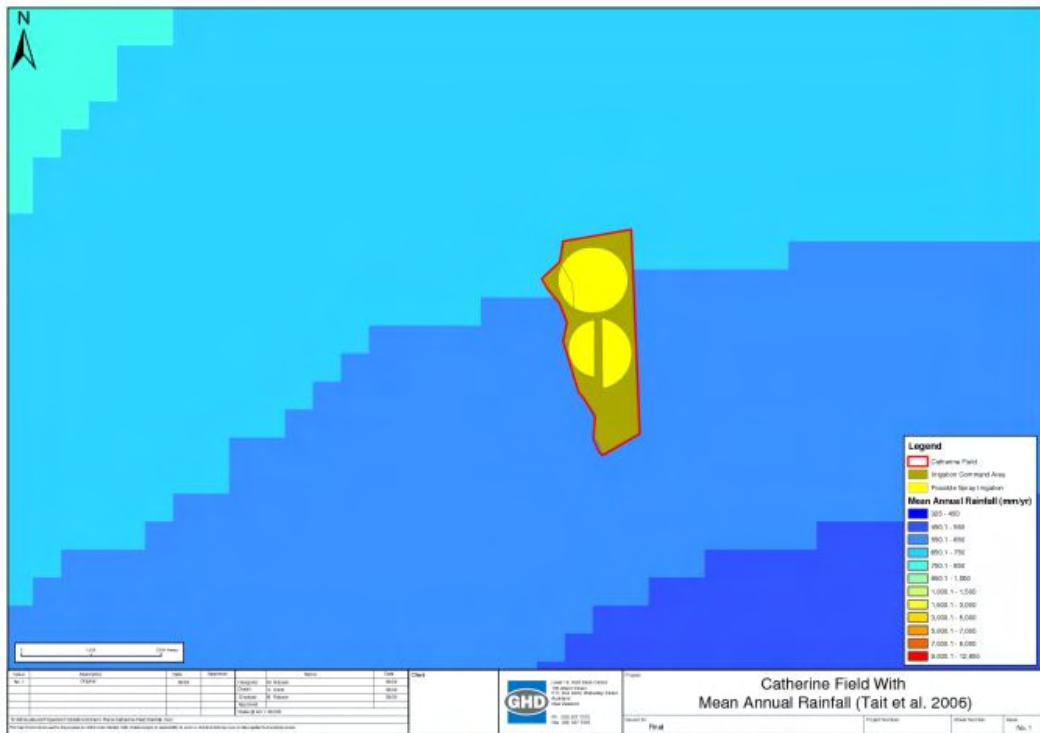
Photo C: Showing the topography.

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

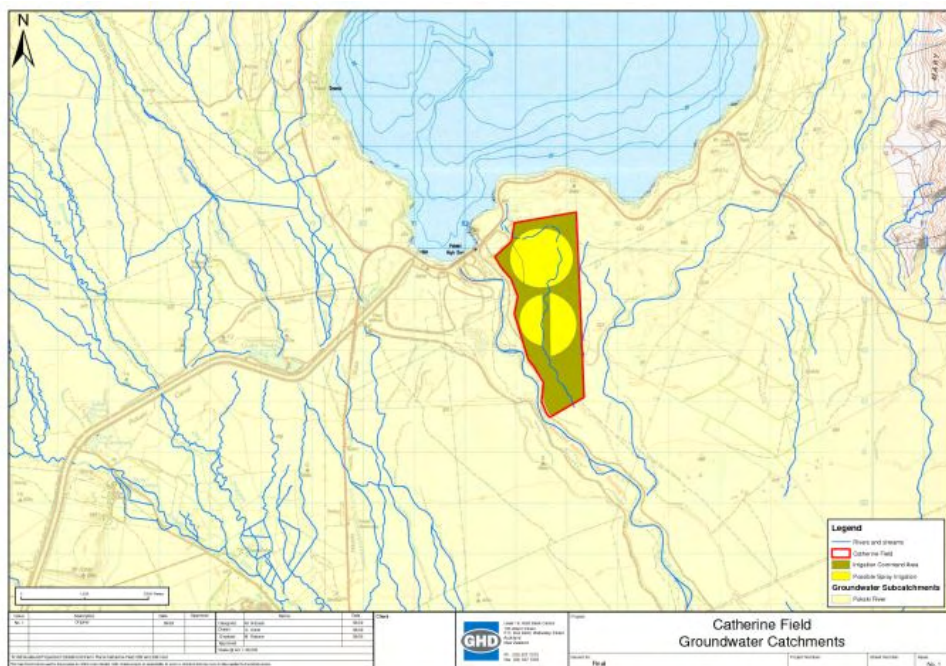
The environmental context of the farm is a reference both to local and wider receiving environments.

3.1 Water Quality Study receiving environments and mitigation requirements

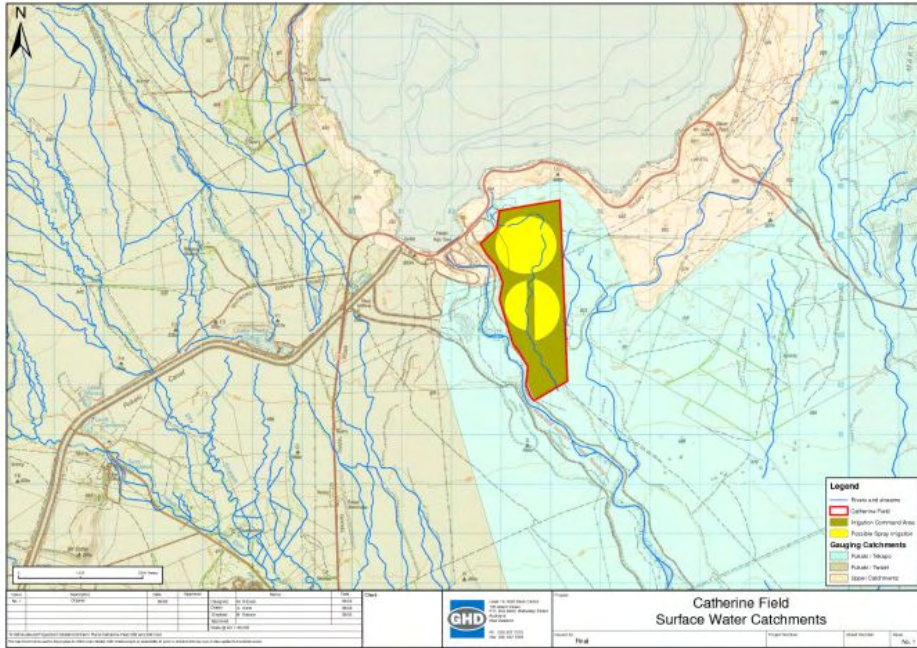
Catherine Fields, according to the WQS, lays in the Pukaki River groundwater catchment and Pukaki/Tekapo surface water catchments. These maps are shown above.

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 along with a small ephemeral stream that occasionally flows on the property in a large rainfall event.

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	<p>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</p> <p>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.</p>
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	<p>Maintaining good crop input records is important for:</p> <ul style="list-style-type: none"> • 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 set out by the WQS. Management or mitigation strategies that have been used to meet this threshold are detailed in Section 5.

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	3939	4432
Total P leaching/runoff	134	135

Note: Catherine Fields has been allocated an additional 17kg of P from a neighbouring property within the same node.

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 Catherine Fields and has highlighted potential soil 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 Site specific management measures and existing mitigation measures in place

1. At Catherine Fields there are culverts placed where stock or vehicles will cross the ephemeral watercourse.
2. There are no permanently flowing waterways within Catherine Fields.

Photo D: Culvert where the track crosses the ephemeral stream. This photo clearly shows the nature of the ephemeral stream which flows very irregularly only in a major rainfall event..



3. There is an existing reticulated trough system to all of the paddocks.
4. Fodder crops are grown as part 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.
5. Cultivation and trafficking

Direct drilling is the primary method for renewing pasture. Chisel ploughing is used where appropriate as it keeps the rough at the top rather than inverting the soil. Inversion tillage is only 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 or chisel ploughing 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 will happen. 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.

6. 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.

7. Runoff

There is no evidence of track runoff 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.

4.3.3 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. One of these general issues has been identified below:

1. 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 hectare across a number of sites within the Mackenzie Basin has been reported. While it cannot be assumed from this information that erosion rates will continue 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.*)
2. Monitoring for the identification of any problems related to the above issue has been included in Table 8.

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**.

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	No application of fertiliser in June or July	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 of a minimum of approximately 50m	Photos and location map	Annual audit after irrigation development completed
3	Irrigation buffer from the Pukaki River of approximately 130mtrs	Photos and location map	Annual audit after irrigation development completed

FEMP stage	Measure	Monitoring	Auditing
3	20 metre layback from any water way when applying fertiliser by land based application e.g. bulk spreader	Field records	Annual Audit report

Map F: Mitigation measures and locations

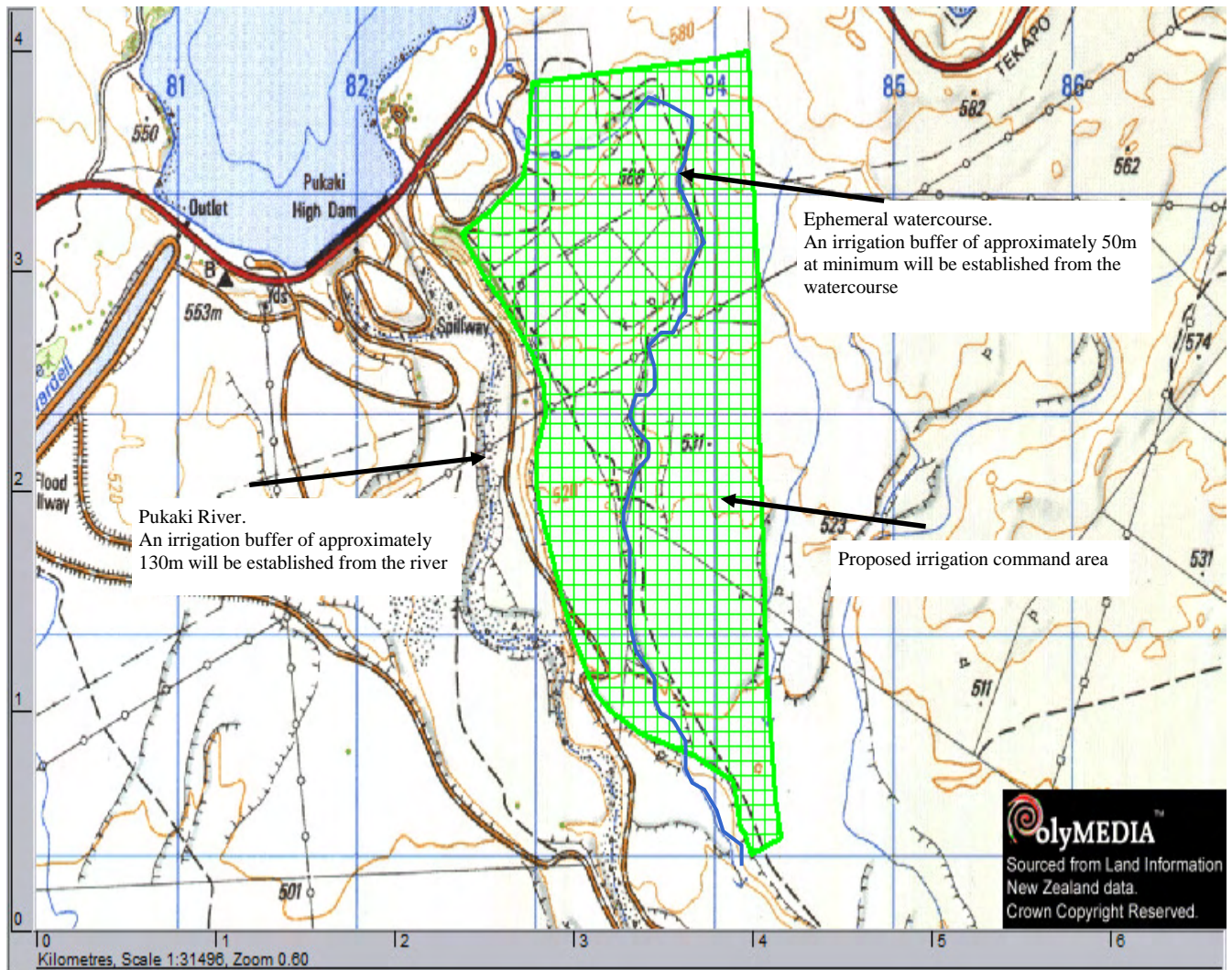
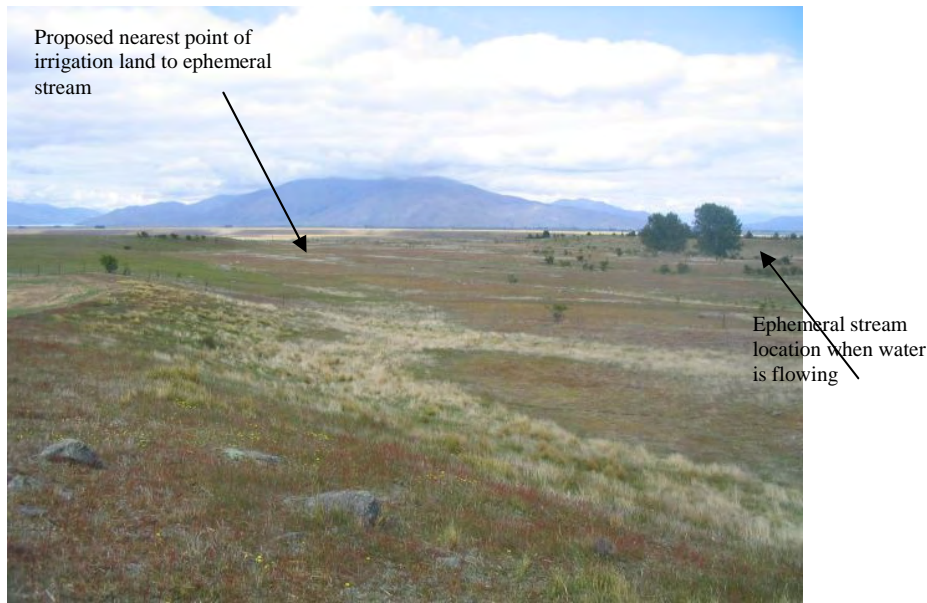


Photo E: Showing the ephemeral water course on the right by the two trees and the closest point of the proposed irrigation land on the left, just at the base of the terrace



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 irrigation paddocks and intensive areas in rotation	1 in 3 years	Standard suite of soil nutrients
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 current monitoring undertaken on Catherine Fields and Table 8 below shows the proposed monitoring plan, frequency, location for the monitoring along with the triggers and contingency plans if the triggers are exceeded.

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	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 rotation	Annually for soil compaction testing.	Soil compaction; surface and subsoil	Compaction, surface capping	Remove compaction with the most appropriate tool
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
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

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 below cover FEMP stages 1, 2 and 3.

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

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 of annual wet weather 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
Fertilisers applied according to code of practice for fertiliser use	Self certification	Any issues should be rectified and identified in next audit
Accounting for all sources of nutrients including applied effluents and soil reservoirs	Reconciliation of fertiliser and soil records with nutrient budget.	Where reconciliation is not verified then this should be rectified at next audit
Even fertiliser application	Calibrate and optimise fertiliser spreaders annually and every 5 years by an external auditor. Signed records for verification	Spreaders not performing shall be recalibrated
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.
Irrigation buffer from ephemeral water course of a minimum of approximately 50m	Check irrigation setback area is present. Photos	Map supplied. Areas of non compliance should be rectified immediately.
Irrigation buffer from the Pukaki River of approximately 130mtrs	Check setback area is present. Photos	Map Supplied. Areas of non compliance should be rectified immediately
20 metre layback from any water way when applying fertiliser by land based application e.g. bulk spreader	Field records and maps	If map not received with annual audit this should be rectified by the 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 and/or existing 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, no permanent waterways on the farm, culverts are installed in the event of above ground water flow. 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?	There are no permanent waterways, culverts are installed in the event of waterflow for stock crossing
4	Any evidence of previous runoff, soil wash or erosion?	No but a potential vulnerability to wind erosion and in some areas reduced ground cover.
6	Do you have a silage pit located near a permanent watercourse?	No
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?	Yes fenced all reticulated water supply
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...?)	Yes, zinc trough, water cannot enter a watercourse
Some guideline questions for biodiversity		
1	Are there any special areas or species of interest or conservation on the farm?	Historic rabbit fence
2	Are there any water or wetland features on the farm?	NO
3	Are these features actively protected?	N/A
Some guideline questions for chemical usage		
	<i>Chemical storage and handling is dealt with under the Hazardous Substances and New Organisms Act</i>	
1	Are those handling chemicals of 'approved handler status'?	Yes contractor used for spraying paddocks
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?	There are no permanent flowing watercourses
Some example questions on cropping		
1	Is inversion tillage used? Describe	Yes possibly discing used if required otherwise direct drilled
2	Are soils left bare over winter?	Not at present but potentially maybe
3	If arable or fodder crops are grown, are measures taken to conserve or build soil organic matter on	Yes

	arable land?	
4	Are remedial measures in place after winter grazed crops?	Yes, straight into pasture or regrowth from the crop
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?	No
Some example questions on pest and weed management		
1	Do you undertake any current pest or weed control? E.g rabbits, gorse	Yes, rabbit fenced