civil tech

Your reference: App-20171209
6 June 2017

The General Manager
Environment Southland
Private Bag 90116
INVERCARGILL

138

ENVIRONMENT SOUTHLAND
07 JUN 2017

Attention: Ms A King

Dear Alex

RE: Application for Expanded Dairy Farm, Renewal of Discharge and Water Permits and Land Use for Dairy Effluent Storage Pond – South Dairy Ltd

Attached is a revised application to expand an existing dairy farm and renewal of the permits to take water and discharge dairy effluent for a 10 year term. The additional information that was provided after the initial application has been included in this application.

The lease agreement was included with the original application and a copy was not retained.

The application fee of $1650.00 was paid with the original application.

Please contact me if you have any questions.

Yours faithfully
Civil Tech Ltd

Murray Gardyne
Director

PO Box 1558, Invercargill 9840, New Zealand
T (03) 216 9745 M 027 435 7957 E murray@civiltech.co.nz

SOUTH DAIRY LTD

Application to Renew Consents for

Discharge Dairy Effluent to Land

Take Groundwater

Proposal Overview and Assessment of Environment Effects

Prepared by

Civil Tech Ltd
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Application for Resource Consent (PART A)

This application is made under Section 88 of the Resource Management Act 1991

environment SOUTHLAND REGIONAL COUNCIL Te Taiao Tonga

The purpose of this Part A form and the relevant Part B form(s) is to provide applications with guidance on information that is required under the Resource Management Act 1991. Please note that these forms are to act as a guide only, and Environment Southland reserves the right to request additional information.

To: Environment Southland
Private Bag 90116
Invercargill 9840

Full name, address and contact details of applicant ***(in whose name consent is to be issued)***

Name: SOUTH DAIRY LTD

Address: 11 McCONNACHIE ROAD

RD 1 WINTON

Email: alexander.farms@vodafone.co.nz

Phone: 027 906 6828 *Preferred* _____ *Additional* Fax: _____

Consultant contact details ***(if different from above)***

Contact name/agent: CIVIL TECH LTD C/- MURRAY GARDYNE

Address: P O Box 1558

INVERCARGILL 9812

Email: murray@civiltech.co.nz

Phone: 03 216 9745 *Preferred* 027 435 7957 *Additional* Fax: _____

Please tick the box for the consent(s) you are applying for and complete the relevant Part B form(s) where available:

Land Use

- [ ] Bore/well
- [x] New or expanded dairy farming
- [ ] Effluent storage
- [ ] Cultivation
- [ ] Tree planting
- [ ] Gravel extraction
- [ ] Hill country burning
- [ ] Riverbed activity (incl. streams/creeks and stopbanks)
- [ ] Bridges and culverts

Discharge

- [ ] To air
- [ ] To water
- [x] To land

Water

- [ ] Take and use surface water
- [x] Take and use groundwater
- [ ] Dam water
- [ ] Divert water

Coastal

- [ ] Whitebait stand
- [ ] Structures/occupation of space
- [ ] Removal of natural materials
- [ ] Disturb foreshore/seabed
- [ ] Discharge/deposit substances
- [ ] Commercial surface water activity
- [ ] Reclaim/drain foreshore/seabed
- [ ] Marine farming
- [ ] Other coastal activities

1 Are there any **current** or **expired** consents relating to this proposal? ☑ Yes ☐ No

If yes, please provide consent number(s) and description:

204476 DISCHARGE (DAIRY)
204477 WATER

2 Are any other consents required from Environment Southland or **other authorities**? ☐ Yes ☑ No

If yes, please state the relevant authority and the type of consent(s) required:

3 For what **purpose** is this consent(s) required: (e.g. discharge of effluent, gravel extraction etc.)

EXPANDED DAIRY FARM

4 **Location** of proposed activity

Address: 373 O'SHANNESSY ROAD

Legal Description: PT SEC 26, 47, 48 AND SEC 49, 51, 52, 53 BLK I WINTON HD & SEC 10 & 11 BLK II WINTON HD.

Map Reference (NZTM 2000): 1241634 E 4873914 N

5 The name and address of the **owner /occupier:** (if other than the applicant)

Name: N.A. Phone:

Address:

6 **Please attach a map or a coloured aerial photograph, showing at a minimum, the location of the proposed activities.**

ATTACHED

Checklist: Have you included the following?

- [x] Payment of the required deposit *(see attached fee schedule)*
- [–] Written approval from all potentially affected parties *(forms available from the Environment Southland website)*
- [x] Site plan/location map/sketch of the proposed activity
- [x] A copy of the Certificate of Incorporation (*where applicant is a company*)
- [x] Part B form(s) specific to your activity and/or a separate assessment of environmental effects (AEE)

Notes:

(a) If your application does not contain the necessary information and the appropriate fee, Environment Southland must return the application.

(b) Council cannot accept electronic lodgement of applications at this time.

Signature of applicant

I hereby certify that to the best of my knowledge and belief, the information given in this application is true and correct.

I undertake to pay all actual and reasonable application processing costs incurred by Environment Southland.

Name (block capitals) MURRAY GARDYNE CIVIL TECH LTD

Signed _____ **Date** 10/2/2017

(Signature of applicant or person authorised to sign on behalf of applicant)

Resource Consent Application for the Discharge of Agricultural Effluent (Part B)

environment SOUTHLAND REGIONAL COUNCIL
Te Taiao Tonga

This application is made under Section 88 of the Resource Management Act 1991

A complete Part A form needs to be provided with this Part B form. The purpose of this Part B form is to provide applicants with guidance on information that is required under the Resource Management Act 1991. These forms are to act as a guide only and Environment Southland reserves the right to request additional information.

Section A: Application details

1. **Please provide details of your existing resource consent to discharge agricultural effluent:**

   (a) Consent number 204476

   (b) Expiry date 9/6/2017

2. **What is the maximum number of animals from which you propose to collect effluent from under this resource consent application?**

   750 animals

Note: if you wish to increase the size of your milking herd, this form is not suitable for your use. Please contact Environment Southland staff for more information.

Section B: Location of discharge and description of surrounding environment

3. **Location of the proposed discharge:**

   Address: 373 O'SHANNESSY ROAD

   Map reference: 1241674E 4873814N

   Legal description PT SEC 46, 47 & 48 AND SEC 49, 51, 52 & 53 BLK I WINTON HD & SEC 10 & 11 BLK II WINTON HD.

4. **Please complete the following tables which tell us about your property and effluent disposal area. Information can be found on the Environment Southland Website in the Beacon application, or by contacting Environment Southland.**

Property Details:-	
Total Farm Area (ha)	250.55
Effective Farm Area (ha)	
Size of effluent disposal area (ha)	200
Stocking rate	3.0
Freshwater Management Unit	LOWER ORETI & MAKARewa

Effluent Disposal Area Details				
Soils	**Soil Type**	**Vulnerability Factors**		
		Structural Compaction	**Nutrient leaching**	**Waterlogging**
	PUKEMOTU	SEVERE	SLIGHT	SEVERE
	EDENDALE	SLIGHT	MODERATE	SLIGHT
	WAIPAWA	MODERATE	MODERATE	MODERATE
	NORTHPE	SEVERE	MODERATE	MODERATE
FDE land classification	Category A – Artificial Drainage or coarse soil structure			✓
	Category B – Impeded drainage or low infiltration			
	Category C – Sloping land (over 7 degrees)			
	Category D – Well drained flat land			
	Category E – Other well drained but very stony flat land			
Physiographic zone (s)	**Zone**	**Contaminant pathway(s) for Physiographic zone**		
	GLEYED	SEE ATTACHED		
	OXIDIZING	"		

5. **Are there are any permanent or intermittent rivers, streams, lakes, drains, ponds or wetlands within 20 metres of the discharge area?**

Yes ☐ (Go to question 7)

No ☑ (Go to question 8)

6. **Features of the rivers, streams, lakes, drains, ponds or wetlands within 20 metres from the discharge area include:**

		Yes	No
(a)	signs of instream life (e.g. fish, eels, bullies, crayfish, native birds, frogs)		
(b)	areas where food is gathered from a water body (e.g. watercress, eels, wildfowl)		
(c)	bird nesting habitats		
(d)	areas of particular aesthetic, cultural, heritage or scientific value (e.g. archaeological sites)		

7. **Are there are any bores or soakholes within 20 metres of the discharge area?**

Yes ☐

No ☑

8. **How many metres is the discharge area from any:**

		Metres from discharge area
(a)	feature	20
(b)	surface waterbodies	20
(c)	artificial watercourses	20
(d)	subsurface drains	0
(e)	the coastal marine area	22 Km
(f)	residential dwellings and places of assembly	200
(g)	landholding boundaries	20
(h)	water abstraction points	100
(i)	registered drinking water supplies	11 Km

10. **Please attach a scaled farm plan or a coloured aerial photograph, showing:**

- ✓ farm boundaries;
- ✓ paddock boundaries;
- ✓ effluent disposal paddocks (numbered and size in hectares);
- – irrigation system layout;
- ✓ tile drains/mole drains; STILL TO COMPLETE
- ✓ streams, rivers, farm drains, springs and wetlands;
- ✓ bores within 100 m of the disposal area;
- ✓ any known water abstraction points within 100 m of the disposal area;
- ✓ buildings (houses, sheds, wintering pads) and/or other places of assembly;
- ✓ effluent storage pond(s) and any effluent treatment infrastructure;
- ✓ cow races;
- ✓ dairy shed location;
- – any other discharge areas (such as whey); NIL
- – any areas prone to flooding;
- – any swampy areas (i.e. where water builds up in the sediments close to the ground surface above layers of poorly draining soils) within the discharge area.

Section C: Description of proposed activity

11. **Dairy shed effluent**

(a) How many cows will be milked each day? 350

(b) How many times per day will you milk (maximum)? once/(twice)/three times per day

(c) What is the length of the milking season? (please include dates) 1 AUG TO 30 MAY days

300 (dates)

(d) What is the volume of wash down effluent generated per day? 37500 (litres/day)

12. Winter milking

(a) Does your milking season include winter milking? NO

(b) If yes, what is the number of cows to be milked in winter? _____ cows

(c) How many times per day will you milk _____ once/twice/three times per day

(d) Dates of winter milking season _____ (provide dates)

13. Feed pad/wintering pad/stand-off pads

(a) Number of cows on feed/~~wintering~~/stand-off pad 520 cows

(b) What is the size of the area? 5600 square metres

(c) Is the feed/wintering/stand-off pad roofed? _____ ~~Yes~~/No

(d) Is rainwater diversion in place? ON 2800m² Yes/No

(e) Is it mechanically swept? ON 2800m² Yes/No

(f) If it is washed down, amount of water used NIL litres/day

(g) How is effluent from this facility disposed of? LIQUID TO STORAGE - SOLIDS SPREAD

(h) Intended length of time the area is to be used up to 90 days per year

14. Please describe any other sources of effluent that is collected for discharge e.g. stock underpasses and silage pads

NIL

15. **Total volume of effluent:**

Using your answers to questions 11-14 (above) what is the total volume of effluent to be discharged (in cubic metres/day)?

AT LEAST 37.5m^3 IF SOIL MOISTURE LEVELS PERMIT. UP TO 120m^3 IN IDEAL CONDITIONS

Effluent irrigation rate and method

16. **Please describe how effluent will be collected, treated and discharged to land and when it will be discharged to land:**

SEE ATTACHED
ALL TO SUMPS & PUMPED EITHER TO LAND OR STORAGE. SPREAD BY TRAVELING & RAIN GUN IRRIGATOR OR SLURRY TANKER & UMBILICAL.

Proposed instantaneous effluent application rate* NA mm/hr

Proposed effluent application depth 5-10 mm per application

*This is the depth of effluent that would be applied to a soil surface if the irrigation system was run continuously for one hour.

17. **Has the effluent irrigator discharge rate been checked and calibrated recently? This is particularly recommended for high rate irrigators.**

- [x] No
- [ ] Yes

If yes, then please include the results of the test.

Section D: Storage facility

18. What volume of effluent storage and treatment do you have on site (m^3)?
Please include a Massey Effluent Pond Calculation to show that you have, or will have sufficient effluent storage.

Effluent Pond/Tank	100	Cubic metres
Sump(s)	25	Cubic metres
Weeping wall/sludge bed	10	Cubic metres
Other (please specify)	–	Cubic metres

19. Are you increasing storage on site?

Yes ☑ (Go to question 20)
No ☐ (Go to question 21)

If you are increasing your storage then please complete the land use consent application form for effluent storage.

20. By how much and to what volume?

5,060 Cubic metres

21. When was your effluent storage and treatment installed? ABOUT 2006

22. Has your current effluent storage pond, tank or structure been certified by a Chartered Professional Engineer as being structurally sound?

No ☑ ASSESSED BY SQN FOR SHORT TERM USE

23. Have you undertaken an Effluent Pond Drop Test that has been certified by a Chartered Professional Engineer?
(Refer to Appendix P of the proposed Southland Water and Land Plan for the Effluent Pond Drop Test methodology (shown at the back of this form))

Yes ☐
No ☑

If you have certification from a Chartered Professional Engineer, please attach the certification to your consent application

24. Pond level drop

Information in this section will be known if you have had a drop test performed on your existing pond. Please contact the Consent Authority for advice as to whether or not you need to perform this test on your storage.

(a) What is the pond level drop for your storage facility? N/A. (mm per 24 hours)

(b) What is the maximum depth of your pond (excluding freeboard 1.5 (metres)

(c) Does your pond level drop exceed the maximum allowable pond level drop (see table below)?

- [ ] No
- [ ] Yes

Maximum Depth of Pond (m) excluding freeboard	Maximum Allowable Pond Level Drop (mm per 24 hours)
<0.5	1.2
0.5 to 1.0	1.4
1.0 to 1.5	1.6
1.5 to 2.0	1.8
>2.0	2.0

Section E: Assessment of Effects

25. **Please describe any possible long term or short term effects the discharge may have on the quality of the receiving environment and including effects on water bodies, biota (plant and animal life), soil quality, and human health:**

SEE ATTACHED

Section F: Good Management Practices and Mitigation Measures

Please include a description of the monitoring or good management practices to be undertaken to help avoid, reduce, remedy or mitigate the actual or potential effects on environmental features and values.

26. Are there any times when you will avoid disposing the effluent to land?

Yes [✓] No [ ]

If **yes**, please indicate below the times you will avoid effluent disposal

(a) When there is snow on the ground ✓

(b) Areas where food is gathered from watercourses (e.g. watercress, eels, wildfowl)? ✓

(c) When rainwater or irrigation water has ponded on the land surface ✓

(d) When the soil temperature is at or below 5 degrees Celsius ✓

(e) When the soil moisture conditions as per Council's monitoring site, or my own soil moisture site say it is unsuitable ✓

(f) Other (please state) MOST YEAR NOT BETWEEN 1 JUNE & 10 AUGUST

To minimise the risk of adverse effects from odour and spray drift, it is recommended that effluent shall not be discharged within 20 metres of the property boundary or 200 metres of any residential dwelling other than those on the subject property. If you cannot adhere to this buffers, then please describe what effects there may be beyond the property boundary resulting from odour and/or spray drift.

27. What contingency plans do you have in place in the event you are unable to discharge the effluent to land, including during bad weather conditions or if any equipment breaks down:

Examples: The capacity of my storage facility is sufficient to defer irrigation in unfavourable weather conditions; or I plan to have the effluent taken off my property.

THE FARM HAS SUFFICIENT STORAGE AS PER DES.C.

28. **What good management practices will you use to avoid or mitigate the effects and the risks of your discharge to the environment? For example: low rate effluent discharge.** *These can be found on the Environment Southland website, including on the relevant Physiographic zone information sheets.*

SEE ATTACHED COLLECTED AGRICULTURAL EFFLUENT MANAGEMENT PLAN.
My maintenance for my effluent system includes: "
The checks I will undertake on my effluent storage and treatment and disposal system to ensure it is not leaking or is not broken are: "
I monitor my effluent discharge by: VISUAL INSPECTIONS

Section F: Other matters

29. **Please specify the duration sought for the resource consent:**

10 years

Please say why you think this consent duration is appropriate for your operation:

THIS IS AN ACCEPTABLE TIME TO COVER THE EXPENSE OF NEW STORAGE POND & FOR STAND-OFF PADS.

30. **Do you have a current collected agricultural effluent management plan?**

Yes ☑ No ☐

This plan can be part of the plan that you have prepared for your farm to meet the requirements of Appendix N of the proposed Plan. If you do have a plan which sets out how you manage your effluent then please include it in this application.

31. **Have you identified any parties which may be affected by the activity?**

Yes ☐ No ☑ CONSIDERED

If **yes**, please indicate below

(a) Neighbours

(b) Other consent holders in the immediate area

(c) Department of Conservation

(d) Iwi (Te Ao Marama Inc; Te Rūnanga O Ngāi Tahu

(e) Local authorities

(f) Fish & Game New Zealand

(g) Other (please state)

Please include evidence of any consultation undertaken for this application.

Section G: Planning Assessment and Declaration

The Resource Management Act 1991 requires you to make your own assessment of your proposal against relevant policies. A separate planning assessment sheet is available to use, or you can do your own assessment. The planning assessment can be found on our website, under the application forms. An assessment must be included with your application.

I hereby certify that to the best of my knowledge and belief, the information given in this application is true and correct.

I undertake to pay all actual and reasonable application processing costs incurred by Environment Southland.

Name (please print) MURRAY GARDYNE

Signed [signature]

Date 10 / 2 / 2017

END OF FORM

Appendix P: Effluent Pond Drop Test methodology

- Testing is undertaken over a minimum period of 48 hours.
- Testing recording equipment is to be accurate to not more than 0.8 mm.
- Continuous readings are to be taken over the entire test period at not more than 10 second intervals.
- Data analysis is undertaken by a party independent of equipment installer.
- Any change in pond fluid level over the test period needs to be accounted for.
- Ponds must be at or over 75% design depth before a test can be undertaken.
- The pond has been de-sludged in the 12 months prior to the test being undertaken and there shall be no sludge or crust on the pond surface during the test.
- The pond surface is not frozen during any part of the testing.
- An anemometer shall be installed for the duration of the test and at no time shall the wind speed exceed 10 metres per second during the test.

Application for a Water Permit (PART B) - To Take and Use Groundwater

environment SOUTHLAND REGIONAL COUNCIL
Te Taiao Tonga

This application is made under Section 88 of the Resource Management Act 1991

A complete Part A form needs to be provided with this Part B form. The purpose of this Part B form is to provide applicants with guidance on information that is required under the Resource Management Act 1991. These forms are to act as a guide only and Environment Southland reserves the right to request additional information. **Please also refer to Appendix A of the Regional Water Plan for Southland, 2010.**

User Charges: Please note that annual User Charges will apply to all water permits. Schedule 6 of Environment Southland's User Charges and Fees document outlines the Annual Research and Monitoring Charges, which you should consider before applying for a water permit. Please refer to www.es.govt.nz/resource-consent/fees for more information on annual user fees and charges.

To: Environment Southland
Private Bag 90116
Invercargill 9840

1 **What is this application for?**

☐ a new groundwater take ☑ the renewal of existing consent no: 204477

2 **What duration of resource consent is sought?** 10 years

3 **For what purpose(s) will the water be used?**

☑ Stock water and/or dairy shed use ☐ Irrigation ☐ Community supply ☐ Commercial/industrial

☐ Other

If other, please describe: _____

4 **Please provide details of the bore(s) from which you wish to take water.** *If you do not have an existing bore, you will need to apply for a consent to construct a bore before you apply to take groundwater. Please refer to the relevant Part B form.*

Bore 1: NZTM 2000 1241910 E 4833199 N Bore number: E46/0342

Bore 2: NZTM 2000 _____ E _____ N Bore number: _____

	Bore depth (m)	Screen depth (m)	Diameter (mm)	Pump type	Pump capacity (l/s)
Bore 1	12m		150ϕ	submersible	1.9
Bore 2					

5 **How much water do you propose to take and at what rate will it be taken?**

Maximum rate of take	1.9	litres per second
Maximum daily volume	90	cubic metres per day
Maximum weekly volume	630	cubic metres per week
Maximum monthly volume	2,790	cubic metres per month
Maximum annual volume	30,445	cubic metres per year

6 **What is the frequency of the proposed water take?**

How many hours per day (maximum)?	14
How many days per week (maximum)?	7
How days per month (maximum)?	31

7 **Please state the name of the aquifer that you propose to take water from.**

MAKAREWA

8 **Do you intend to store your water before subsequent use?**

If yes, what/how much storage will be provided? 45 m^3

What type of storage facilities are proposed? CONCRETE TANKS

You may need a building permit and/or additional resource consents for the construction of storage facilities.

9 **What type of water metering system is installed or proposed to be installed?** Environment Southland prefers all takes for 5 l/s or more to be fitted with telemetry to report in line with the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010.

☑ Water meter ☐ Data logger ☐ Telemetry

10 If you propose to use water for stock and/or dairy shed use – please answer the following:

(a) What type of animal and numbers of stock will be supplied with water for drinking?

☐	Sheep	Number:		Water required:		litres/head/day
☐	Beef cattle	Number:		Water required:		litres/head/day
✓	Dairy cows	Number:	350	Water required:	70	litres/head/day
☐	Other	Number:		Water required:		litres/head/day

(b) How much water do you require for your dairy shed? 50 litres/head/day

11 If you propose to use water to irrigate land – please answer the following: NA

(a) How many hectares of land will be irrigated? _____

(b) What is the soil type(s) of the land being irrigated _____

(c) What will you be irrigating (i.e. crop, pasture etc)? _____

(d) What type of irrigation system will be used? _____

(e) What is the target application rate (mm/day and mm/year)? _____

(f) How have you calculated the amount of water you need? (attach separate pages if required)

_____

12 If you propose to use water for industrial use – please answer the following: NA

(a) What type of industry will be using the water and how will the water be used?

_____

(b) How have you calculated the amount of water you need? (attach separate pages if required)

_____

13 **If you propose to use water for commercial/domestic supply – please answer the following:**

(a) What type of establishment will use the water?

- ☐ Households – number of households to be supplied: _____
- ☐ Camping grounds – maximum number of visitors and staff per year: _____
- ☐ Schools – maximum number of students and staff per year: _____
- ☐ Motel units – number and expected occupancy: _____
- ☐ Other: _____

(b) How have you calculated the amount of water you need? (attach separate pages if required)

_____

14 **If you propose to use water for any other purpose, please describe the amount of water you will need and how this has been calculated (please attach a separate sheet to this application, if necessary).**

HA

15 **Please describe any other sources of water available for the property. Describe how much water is available and what it is used for.**

HA

16 **Please also describe any measures you are proposing to minimise wastage of water and maximise its efficient use:**

AS PER BEST PRACTICE

17 **Does your proposed water take have any associated discharges? If yes, please describe.**

☑ Yes ☐ No

Please note that a discharge into the environment may require a resource consent application to be made specifically for the discharge (please refer to the relevant Part B form).

SEE ATTACHED FORM

Existing Environment

18 **Are any of the following features found within the existing environment of the proposed activity? Describe these features in the space below, along with details of the assessment undertaken to determine the presence of these features.**

	Yes	No
(a) Signs of instream life (e.g. fish, eels, bullies, crayfish, native birds, frogs)?	✓	
(b) Areas where food is gathered from a water body (e.g. watercress, eels, wildfowl)?		✓
(c) Wetlands, wildlife habitats or bird nesting habitats (e.g. swamp areas)?		✓
(d) Other activities occurring in the area (e.g. commercial activity, fishing, swimming, boating)?		✓
(e) Areas of particular aesthetic, cultural, heritage or scientific value (e.g. archaeological sites)?		✓
(f) Waste discharges and/or monitoring sites?		✓
(g) Other water takes?		✓
(h) Surface water bodies? Natural springs?		✓

ASSESSMENT FROM OWNER/OCCUPIERS OBSERVATION.

Please also include a map or aerial photograph showing the following:

- [x] the location(s) of the existing points of take;
- [ ] the location of proposed points of take(s);
- [x] the location of water measuring device(s); BY BORE
- [x] the total property area boundary;
- [ ] the area(s) to be irrigated (if relevant);
- [ ] the area(s) of community supply (if relevant);
- [ ] distances to any discharge activities;
- [ ] other surface water bodies and wetlands nearby and the distance from the point of take(s) to them;
- [ ] the coastline and the distance to it (if relevant);
- [x] the location of any dairy sheds (if relevant).

Assessment of Effects

19 Will the take and use of groundwater have any effects on the following:

LESS THAN MINOR

	Yes	No
(a) Aquifer storage volumes		✓
(b) Existing bore or well yields		✓
(c) River and stream flows, including minimum flows and allocation levels		✓
(d) Wetland and lake water levels		✓
(e) Groundwater quality		✓

*For those answered **No** above, please describe why there will be no effects. For those answered **Yes**, please describe how these effects may occur.*

SEE ATTACHED.

20 **Pursuant to Schedule 4 of the Resource Management Act, 1991, there are a number of matters that must be addressed by an assessment of environmental effects. Please discuss what effects the proposed activity will have on the following:**

(a) any effect on those in the neighbourhood and, where relevant, the wider community, including any social, economic, or cultural effects

THIS IS AN EXISTING PERMITTED ACTIVITY. THE NEIGHBOURHOOD WILL NOT CHANGE. THE ADDITIONAL AREA WAS DAIRY GRAZING BY SOUTH DAIRY.

(b) any physical effect on the locality, including any landscape and visual effects

NO VISIBLE CHANGE AS THE POND IS BEHIND A HEDGE.

(c) any effect on ecosystems, including effects on plants or animals and any physical disturbance of habitats in the vicinity

NO CHANGE IN EFFECTS OR PHYSICAL DISTURBANCE AS ALL CONSTRUCT IS AT GROUND LEVEL.

(d) any effect on natural and physical resources having aesthetic, recreational, scientific, historical, spiritual, or cultural value, or other special value, for present or future generations

NO CHANGE IN VALUES. PLANNING FOR FUTURE GENERATION & SUPPORTING LOCAL INDUSTRY & COMMUNITY PROPERTY.

(e) any discharge of contaminants into the environment, including any unreasonable emission of noise, and options for the treatment and disposal of contaminants

NO

(f) any risk to the neighbourhood, the wider community, or the environment through natural hazards or the use of hazardous substances or hazardous installations

NO

21 **Please include a description of the monitoring or mitigation measures (including safeguards and contingency plans where relevant) to be undertaken to help avoid, reduce, remedy or mitigate the actual or potential effects on environmental features and values.**

WATER VOLUMES ARE RECORDED

22 **Please include a description of any possible alternative locations or methods for undertaking the activity and why these alternatives have not been selected.**

USE OF GROUND WATER REDUCES THE RISK OF CONTAMINATION.

23 **Please include evidence of any consultation undertaken for this application. This may include (but not be limited to) consultation with adjoining landowners, other consent holders in the immediate area, iwi (e.g. Te Rūnanga O Ngāi Tahu, Te Ao Marama Inc.), government departments/ministries (e.g. DOC), territorial authorities and recreational associations.**

24 **Appendix A of the Regional Water Plan for Southland, 2010, details the level of further assessment required as part of your application. This may include the following assessments (please attach as a separate report):**

- ☐ interference effects/drawdown;
- ☐ radius of influence;
- ☐ stream depletion effects;
- ☐ an assessment of the dynamic aquifer response to abstraction.

25 **Appendix L of the proposed Southland Water and Land Plan, 2016, details the level of further assessment required as part of your application. This may include the following assessments (please attach as a separate report):**

- ☐ aquifer test requirements;
- ☐ stream depletion effects;
- ☐ interference effects;
- ☐ calculation of seasonal groundwater allocation;
- ☐ establishing allocation volumes for confined aquifers.

Please note that in accordance with Schedule 4 of the RMA, you may also be required to provide an assessment of whether or not the proposed activity is contrary to any of the relevant provisions of the following documents.

(a) Regional Policy Statement for Southland, 1997
(b) Proposed Southland Regional Policy Statement, 2012 (and any proposed/ subsequent versions)
(c) Regional Water Plan for Southland, 2010
(d) Proposed Southland Water and Land Plan, 2016 (and any proposed/ subsequent versions)
(e) National Policy Statement for Freshwater Management, 2014
(f) National Environmental Standard for Sources of Human Drinking Water, 2007
(g) Resource Management (Measurement and Reporting of Water Takes) Regulations, 2010

Staff are able to advise whether this is required, as it is dependant on the location, scale and complexity of your proposal. We invite you to come in for a pre-application meeting with Environment Southland consents staff to discuss this.

END OF FORM

Application to Construct Effluent Storage (PART B)

This application is made under Section 88 of the Resource Management Act 1991

ENVIRONMENT SOUTHLAND

A complete Part A form needs to be provided with this Part B form. The purpose of this Part B form is to provide applicants with guidance on information that is required under the Resource Management Act 1991. These forms are to act as a guide only and Environment Southland reserves the right to request additional information. **This form must be used when applying for consent to construct effluent storage, including waste-water, sludge or effluent from an industrial or trade processes or agricultural effluent (including treatment facilities, such as weeping walls and sludge beds).**

To: Environment Southland
Private Bag 90116
Invercargill 9840

7 **Location of the storage:**

Address: 373 O'Shannessy Road

Legal Description(s): Sec 51 Blk I Winton Hundred

Map Reference (NZTM 2000): 12418280E, 4873900N

8 **Proposed method of lining the pond.**

☐ Compacted clay ☑ Synthetic liner ☐ Concrete
☐ Other:

8 **Construction Details:**

Name of designer: Civil Tech Ltd and Hadley Consultants Ltd

Name of builder: Dean Shearing

Name of construction supervisor: Murray Gardyne

Proposed timing of construction: April - May 2017

For agricultural effluent storage and sludge design, is the storage to be constructed in accordance with IPENZ Practice Note 21: Farm Dairy Effluent Pond Design and Construction (2013)? If not, please advise what departure from the standards is proposed and why.

Yes

6 **Please provide details of the proximity of the storage to:**

Nearest surface watercourse:	450	metres
Nearest artificial watercourse:	450	metres
Registered drinking water supplies:	11,900	metres
Nearest underground drain:	20	metres
Property boundary:	240	metres
Dwellings on neighbouring properties:	880	metres
Coastal marine area:	24,300	metres
Historic heritage	(E469) 3,000	metres
Urban areas	(Winton) 4,900	metres

7 **What is the total volume of the pond and the the storage and purpose?** Agricultural Effluent 5,590 cubic metres

8 **Please provide a description of all of the sources of waste-water, sludge or effluent to be treated and/or stored in the storage, including the storage capacity of the effluent storage in relation to the volume and nature of the liquid that will enter. For agricultural effluent, you must also attach a Massey Pond Calculator assessment of storage requirements.**

The waste water will originate from the dairy shed and yards, feed/stand-off/calving pad.

9 **Please provide a description the quality of the waste-water, sludge or effluent. Please include all operational procedures, emergency response and proposed monitoring devices to match the scale and quality of the waste-water, sludge or effluent being stored and sensitivity of surrounding environment.**

This is part of the farms Collected Agricultural Effluent Management Plan.

Please include engineering drawings for the proposed structure(s). This will include, but not be limited to the height of the embankments and placement and orientation of the effluent storage relative to flood flows and stormwater run-off.

Please also include a map or aerial photograph showing the following:

2 the location of the proposed storage;
3 the total property area boundary;
4 surface water bodies, artificial watercourses, installed subsurface drains and wetlands nearby;
5 water supplies - bores, registered drinking etc ;
6 the coastal marine area and the distance to it (if relevant);
7 the location of any dairy sheds and residential dwellings; and
any additional points of interest – historic heritage, places of assembly etc.

Please note that upon completion of the storage and prior to discharge, you will be required to provide certification of the design and build by a Chartered Professional Engineer.

END OF FORM

NEW ZEALAND | COMPANIES

Certificate of Incorporation

SOUTH DAIRY LIMITED

613630

NZBN: 9429038757297

This is to certify that SOUTH DAIRY LIMITED was incorporated under the Companies Act 1955 on the 13th day of December 1993 and was reregistered to become a company under the Companies Act 1993 on the 23rd day of April 1997.

REGISTRAR OF COMPANIES NEW ZEALAND

Registrar of Companies
13th day of April 2017

For further details relating to this company check
http://www.companies.govt.nz/co/613630
Certificate generated 13 April 2017 08:29 AM NZST

SCAN TO VIEW OUR REGISTRATION DETAILS

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**SLA4/1044**
Land Registration District	**Southland**
Date Issued	15 September 1969

Prior References
SL8/14

Estate	Fee Simple
Area	39.0059 hectares more or less
Legal Description	Part Section 47 Block I Winton Hundred

Proprietors
South Dairy Limited

Interests
220236.8 Mortgage to (now) Westpac New Zealand Limited - 18.5.1994 at 11.15 am
8422692.1 Variation of Mortgage 220236.8 - 25.2.2010 at 9:13 am

Transaction Id
Client Reference *Civil Tech Ltd*

Search Copy Dated 17/01/17 11:17 am, Page 1 of 2
Register Only

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**SL8B/119**
Land Registration District	**Southland**
Date Issued	20 March 1987

Prior References
SL11/299

Estate	Fee Simple
Area	32.0941 hectares more or less
Legal Description	Section 51 Block I Winton Hundred

Proprietors
South Dairy Limited

Interests

220236.8 Mortgage to (now) Westpac New Zealand Limited - 18.5.1994 at 11.15 am

8422692.1 Variation of Mortgage 220236.8 - 25.2.2010 at 9:13 am

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**SLA3/344**
Land Registration District	**Southland**
Date Issued	30 May 1968

Prior References
SL3/62

Estate	Fee Simple
Area	19.9181 hectares more or less
Legal Description	Section 52 Block I Winton Hundred

Proprietors
South Dairy Limited

Interests

220236.8 Mortgage to (now) Westpac New Zealand Limited - 18.5.1994 at 11.15 am

8422692.1 Variation of Mortgage 220236.8 - 25.2.2010 at 9:13 am

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952
Limited as to Parcels

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**SL135/228**
Land Registration District	**Southland**
Date Issued	21 March 1929

Prior References
DI C1775 DI C568

Estate	Fee Simple
Area	19.5691 hectares more or less
Legal Description	Section 53 Block I Winton Hundred

Proprietors
South Dairy Limited

Interests
220236.8 Mortgage to (now) Westpac New Zealand Limited - 18.5.1994 at 11.15 am
8422692.1 Variation of Mortgage 220236.8 - 25.2.2010 at 9:13 am

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R. W. Muir
Registrar-General
of Land

Identifier	**309944**
Land Registration District	**Southland**
Date Issued	17 May 2007

Prior References
SL2A/503

Estate	Fee Simple
Area	15.4515 hectares more or less
Legal Description	Lot 2 Deposited Plan 377137

Proprietors
South Dairy Limited

Interests

Appurtenant hereto is a right of way created by Easement Instrument 7374039.3 - 17.5.2007 at 9:00 am

The easements created by Easement Instrument 7374039.3 are subject to Section 243 (a) Resource Management Act 1991

Land Covenant in Easement Instrument 7374039.3 - 17.5.2007 at 9:00 am

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**309945**
Land Registration District	**Southland**
Date Issued	17 May 2007

Prior References
SL2A/503

Estate	Fee Simple
Area	2.5460 hectares more or less
Legal Description	Lot 3 Deposited Plan 377137
Proprietors	
South Dairy Limited	

Interests

7374039.1 Consent Notice pursuant to Section 221 Resource Management Act 1991 - 17.5.2007 at 9:00 am

Subject to a right of way over part marked A on DP 377137 created by Easement Instrument 7374039.3 - 17.5.2007 at 9:00 am

The easements created by Easement Instrument 7374039.3 are subject to Section 243 (a) Resource Management Act 1991

Land Covenant in Easement Instrument 7374039.3 - 17.5.2007 at 9:00 am

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**SLB3/786**
Land Registration District	**Southland**
Date Issued	11 August 1966

Prior References
SL148/158

Estate	Fee Simple
Area	33.1842 hectares more or less
Legal Description	Section 11 Block II Winton Hundred

Proprietors
South Dairy Limited

Interests

220236.8 Mortgage to (now) Westpac New Zealand Limited - 18.5.1994 at 11.15 am

8422692.1 Variation of Mortgage 220236.8 - 25.2.2010 at 9:13 am

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

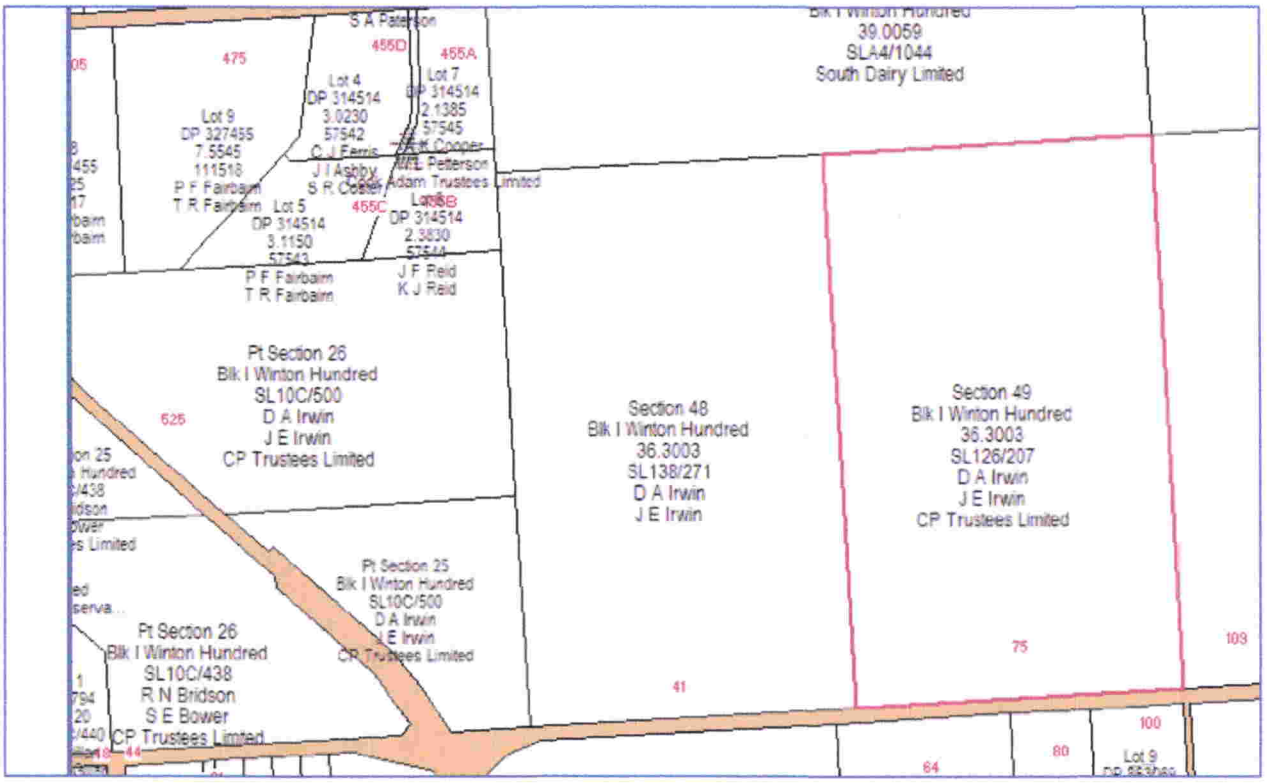
Identifier	**SLA4/1043**
Land Registration District	**Southland**
Date Issued	15 September 1969

Prior References
SL8/14

Estate	Fee Simple
Area	1019 square metres more or less
Legal Description	Lot 1 Deposited Plan 7035

Proprietors
South Dairy Limited

Interests



Land lease blocks Pt Sec 25-26, Sec 48-49.

Under lease agreement with Irwin D A & JE, CP Trustees Ltd.

The lease agreement is attached. It is for a 4 year term with a 4 year right of renewal. South Dairy Ltd has been leasing land from this neighbour for 16 years beginning with some included in the last discharge permit area so this is an ongoing arrangement and have first right of purchase in the future.

1.0 Overview

Applicant:	South Dairy Ltd
Application:	Replace discharge and water permits for an expanded dairy farm with new effluent storage pond. The stocking rate, at 3.0 cows/ha will remain the same
Location;	373 O'Shannessy Road
Legal description:	Sec 51, 52, and Pt sec 47 Blk I Winton SD and Sec 11 Blk 2 Winton SD and Lt 1-3 DP 377137 *And lease of:* Pt Sec 25-26, Sec 48, 49 Blk I Winton SD
Map Reference:	NZTM 2000 1241674E, 4873814N

Property details:

Catchment	Lower Oreti and Makarewa
Total farm area (ha)	250.55
Replacement consents	Yes, more cows on larger area and increased discharge disposal area.
Physiographic	Gleyed and Oxidizing
Freshwater Management Unit	75% Lower Aparima, 25% Makarewa

Soils

	Vulnerability Factors		
	Structural compaction	Nutrient leaching	Waterlogging
Soil name			
Pukemutu	severe	slight	severe
Edendale	slight	moderate	slight
Waianiwa	moderate	moderate	moderate
Northope	severe	moderate	moderate

FDE land classification Category A

Characteristics of FDE classification Artificial drainage or coarse soil structure, some multiple risk

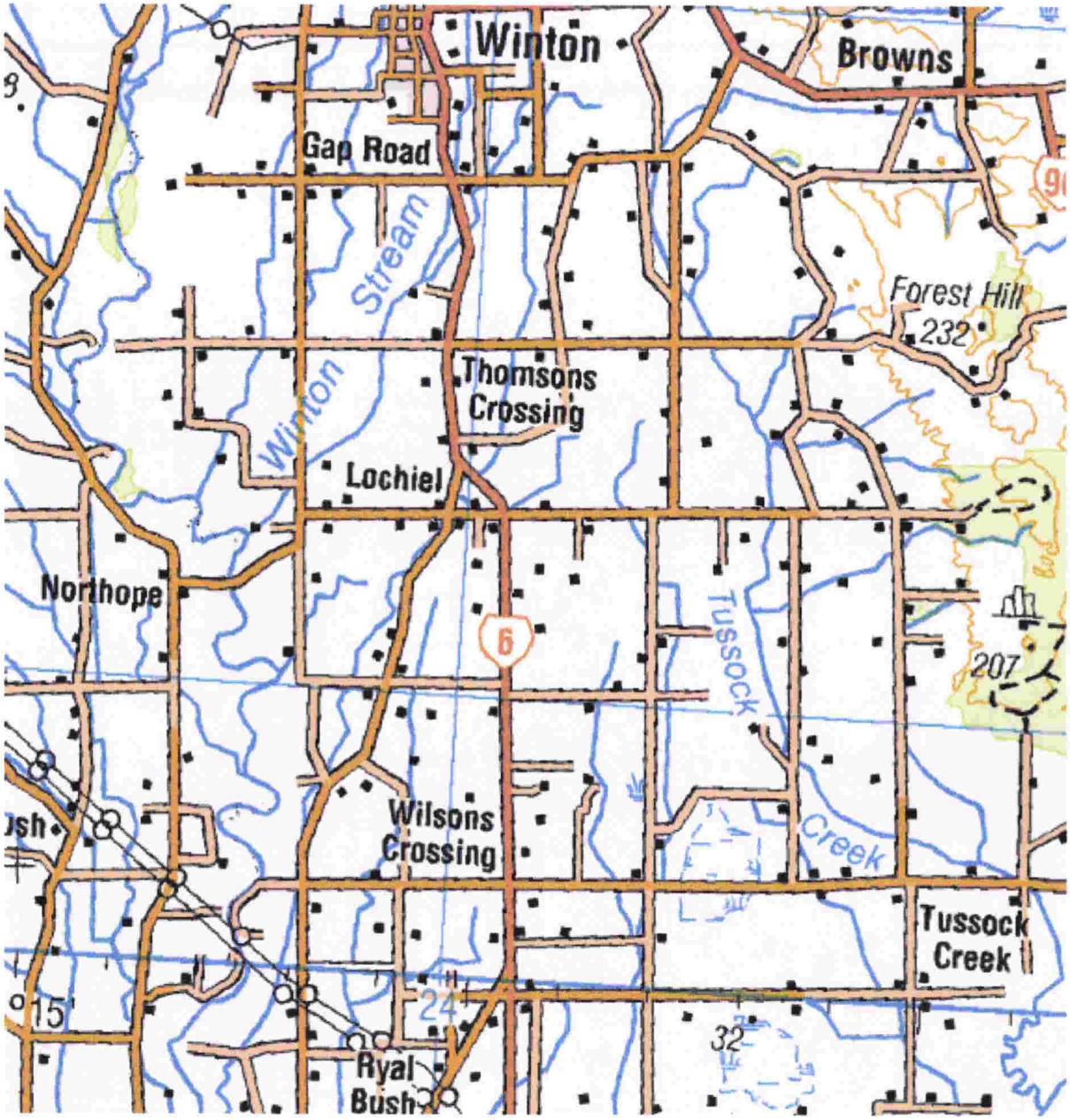
Groundwater nitrate levels 75% - 1.0 – 3.5 mg/l – Minor to moderate land use impacts
25% - 3.5 – 8.5 mg/l – Moderate to high land use impacts

Physiographic Zones

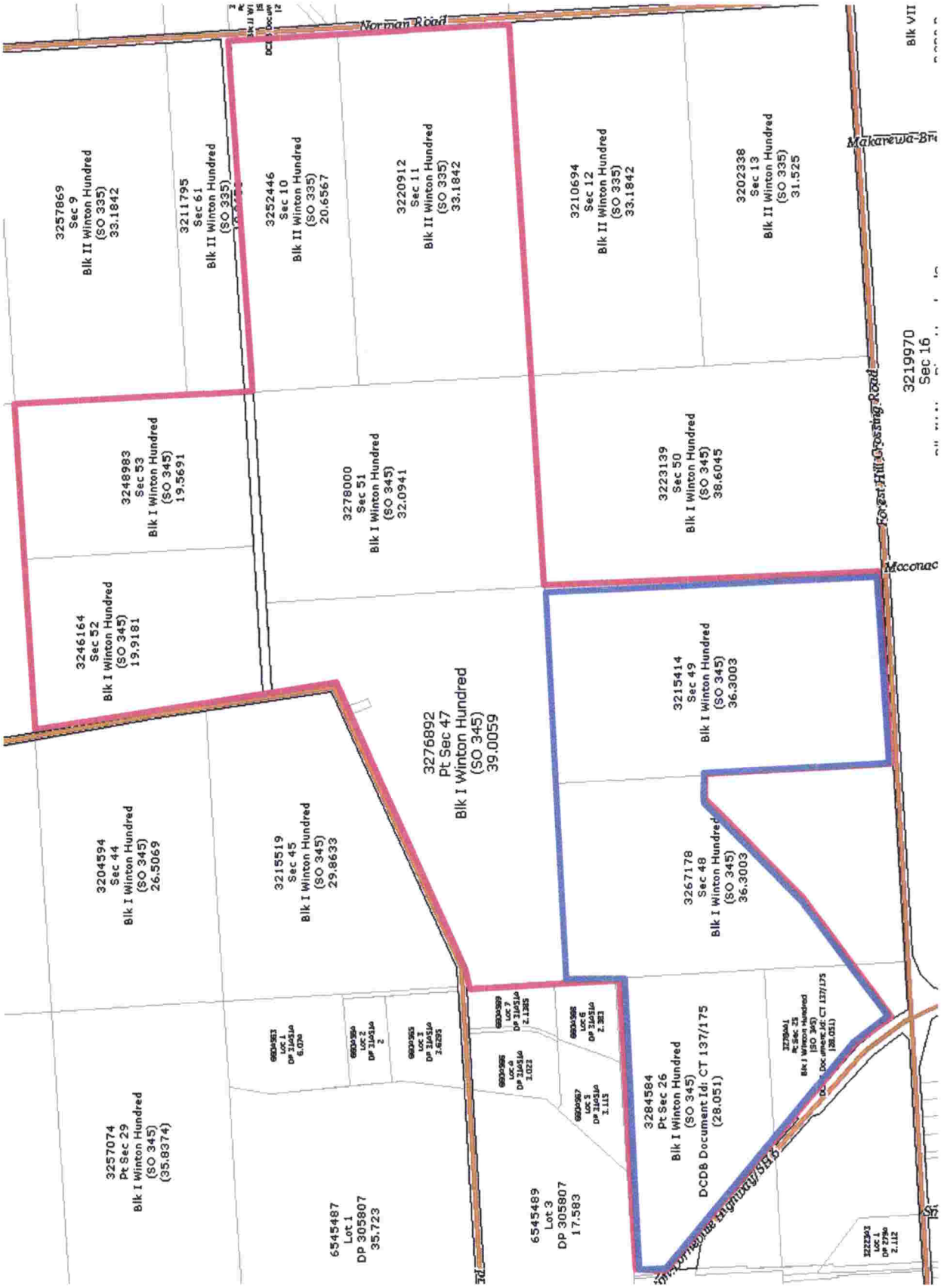
Zone	Contaminants pathways for zone
Gleyed	Artificial drainage rapidly moved excess soil water and contaminants to rivers and streams
Oxidizing	High risk of nitrogen build-up in groundwater. Following heavy rain or prolonged rainfall, contaminant losses to rivers and streams may occur via overflow or artificial drainage.

The dairy farm is the same area as the original area except the original Appendix 1 did not include the leased land that was part of the farm. The farm had fewer cows and was operated as almost a self-contained unit but now it will be mainly a milking platform with less replacements and winter grazing on the farm. Therefore the application is for a renewal of the dairy farm discharge and water permits at a lower stocking rate with the corrected Appendix 1.

LOCALITY MAP



LEGAL PLAN



Farm boundary indicated in red. Blue boundary indicates land used under lease agreement.

2.0 Consents Required

Resource consents are required under the Regional Effluent land Application Plan (RELAP), operative Regional Water Plan for Southland (RWP) and proposed Southland Water and Land Plan (pSWLP).

Regional Effluent Land Management Plan

- The discharge of dairy shed effluent to land is a discretionary activity under Rule 5.4.6.

Regional Water Plan for Southland

- The construction of the effluent pond is a restricted discretionary activity under Rule 49.
- The taking of water is a restricted discretionary activity under Rule 18 (d) (iv)

Under the RWP the application is considered to be for a restricted discretionary activity.

Proposed Southland Water and Land Plan

- The taking of water is a permitted activity under Rule 49 (a)
- The use of land for dairying is a permitted activity under Rule 21.
- The discharge of effluent to land is a discretionary activity under Rule 35 (c).
- The construction of the effluent storage facility is a restricted discretionary activity under Rule 32 (b).
- Rule 3 – for controlled or restricted discretionary activities

Under the pSWLP the application is considered to be for a non-complying activity.

Overall, the application would be is considered to be a non-complying activity.

A Suitably Qualified Person was able to design and sign off the construction of an effluent storage pond under Rule 49. In this application the design and construction will be signed off by Murray Gardyne of Civil Tech Ltd who has been involved with the construction of more than 300 ponds in Southland and Otago and sign off of at least 150 ponds in Southland since Rule 49 was established. The effect on the environment of this sign off will be no different than a CPEng as I, an associate member of IPENZ, am required to follow the same code of ethics as a CPEng and have the same value insurance cover. No insurance cover for any pond has been required over the past 10 years that I have been involved in ponds since asked to assist Environment Southland in 2007. The effect on the environment will be less than minor.

3.0 Statutory Considerations

Section 104 of the Act sets out the matters that must be considered when assessing an application for a resource consent. Section 104(1) of the Resource Management act, 1991, states:

(1) When considering an application for a resource consent and any submission received, the consent authority must, subject to part 2, have regard to:

(a) any actual and potential effect on the environment of allowing the activity : and

(b) any relevant provisions of –

- *(i) a national environment standards:*
- *(ii) other regulations:*
- *(iii) a national policy statement:*
- *(v) a regional or proposed regional policy statement*
- *(vi) a plan or proposed plan, and*

(c) any other matter the consent authority considers relevant and reasonably necessary to determine the application.

Those matters which are relevant for this application are discussed in the following sections.

Part 2 of the Resource Management Act 1991

This application is consistent with the purpose and the principles of the Act, as set out in Section 5. The proposed activities will have no more than minor adverse effects on the ability of the receiving environment to meet the reasonable foreseeable needs of future generations, or on the life – supporting capacity of the land or any ecosystem associated with it. Proposed consent conditions will ensure that any potential adverse effects of the activities will be avoided, remedied or mitigated.

There are no matters of national importance, as outlined in Section 6 of the Act, that may be affected by the proposed activities. The application is also consistent with Section 7 of the Act, with particular regard given to the maintenance and enhancement of the quality of the environment. With regard to Section 8 of the Act, the proposed activities are not inconsistent with the principles of the Treaty of Waitangi.

Actual and potential effects (Section 104(1)(a))

The actual and potential effects of the proposed activities were considered earlier in the application. Conditions of consent will ensure that any adverse effects are avoided, remedied or mitigated.

Relevant provisions of national policy statement (Section 104(1)(b)(iii)

The policies of the National Policy Statement for Freshwater Management that are relevant to this application are:

Policy A2	Specify targets and implement methods in a way that considers the sources of relevant contaminants to assist the improvement of water quality.
Policy B2	Regional Council making or changing regional plans to be the extent needed to provide for the efficient allocation of freshwater.
Policy B5	Ensuring that no decision will likely result in future over-allocation.
Policy C1	Regional council managing freshwater and land use and development in catchments in an integrated and sustainable way, so as to avoid, remedy or mitigate adverse, including cumulative effects.
Policy D1	Involve iwi/hapu in the management of freshwater, identify tangata whenua values and interests in freshwater, and reflect tangata whenua values in the management of, and decision-making regarding freshwater.

With regard to policies A3 and A4, the Council has set objectives and limits for freshwater under the Regional Water Plan. The discharge in this instance is to land, and conditions are imposed to avoid or minimize effects on water.

Policies B5 and B7 seek to protect the life supporting capacity of the fresh water resources. The Council must have regard to the available allocations of such resources and ensure that consent applications do not cause an adverse effect on the natural variability of flow of any fresh water body. This proposal has discharge to land and best practice for effluent management and will have standard conditions set by Council avoid and minimize effects on water quality. To help maintain the quality of fresh water, low rate irrigation, sufficient storage to enable deferred irrigation during adverse soil conditions will minimize groundwater surface water degradation. The volume of abstraction is considered to be at a rate and daily volume sufficiently low that there would be a less than minor effect on ecosystem processes and water quality. The abstraction volume represents efficient use of water. The total volume allocation status from the Lower Oreti aquifer low. The farm management practices integrate well with the freshwater requirements.

Consideration of Te Tangi a Tauira and existing agreements with Te Ao Marama Inc address Objective D1 and Policy D1.

Relevant provisions of the Southland Regional Policy Statement (Section 104(i)(b)(v))

The following policies in the Regional Policy Statement are of particular relevance to this application:

Policy 4.3	Manage abstraction of water on the basis of the effects of that abstraction, taking into account the standards set for the waterbody and the use to which the water is to be put.
Policy 4.4	Encourage the conservation of water and its efficient allocation and use.
Policy 4.5	In considering resource consents, local authorities shall assess the effects of land use and development on the quality and sustainability of water in water bodies and provide for any adverse effects to be avoided, remedied or mitigated.
Policy 5.4	Utilise land treatment of liquid wastes where this can be undertaken in a sustainable manner and without significant adverse environmental effects.
Policy 5.5	In considering resource consents, local authorities shall assess the effects of land use and development on groundwater and surfacewater, including both point and non-point source discharges, and provide for any adverse effects to be avoided, remedied or mitigated.

Comment

These provisions seek to avoid or to minimize adverse effects on the Region's water resources and encourage the conservation of water and its efficient allocation and use.

In particular, Policy 5.5 refers to non-point source discharges which may affect water quality which is an important consideration when assessing the potential cumulative effects of intensive grazing.

The proposed activities are not contrary to the Southland Regional Policy Statement as these provide for the proposed activity.

Relevant provisions of the Proposed Southland Regional Policy Statement 2012 (Section 104(1)(b)(v))

The following objectives and policies in the proposed Regional Policy Statement are of particular relevance to this application:

Objective TW.2	provision for iwi management plans
Policy TW.3	Take iwi management plans into account
Objective WQUAL.1	Water quality goals
Policy WQUAL.1	Identify values of surfacewater and groundwater that should be maintained, and manage discharges and land use activities to maintain or enhance water quality.
Objective WQUAL.2	Lowland water bodies
Policy WQUAL.2	Maintain and enhance water quality by managing activities to reduce the levels of nitrogen and phosphorus, sediment, and microbiological contaminants.
Policy WQUAL.5	Prefer discharges to land over discharge to water.
Objective WQUAL.1	Sustainably managing the region's water resources

Objective WQUAL.2	The efficient use of water
Policy WQUAL.2	Avoid over-allocation of surfacewater and groundwater
Policy WQUAN.6	Efficient use of water
Objective RURAL.1	Sustainable land use in rural areas
Policy RURAL.1	Use and development of rural resources enables economic, social and cultural wellbeing

Comment

The application is consistent with Policy WQUAN.6 which seeks to ensure that the water use for the activity is efficient. The activity is seeking an abstraction which is in accordance with Council's estimated use for dairy operations.

The proposed activity is consistent with water quality policies in maintaining through management of discharges and land use, the existing surface and groundwater quality in the area [WQUAL.1, WQUAL.2, WQUAL.5]. The proposed works meet the Council's preference for discharge to land [WQUAL.5].

Policy TW. Requires that iwi management plans, such as Te Tangi a Tauira, be taken into account.
The proposed activity is partly consistent with water quality objectives and policies of the Proposed Southland Regional Policy Statement in maintaining, through management of discharges and land use, the existing surface and groundwater quality in the area. Proposed mitigation measures include more than adequate effluent storage for deferred irrigation, and low rate irrigation. The farm also uses the preference for discharge to land. The conditions requiring water quality and quantity monitoring will contribute to data already held regarding the region's water resources. The aquifer is not fully allocated. The property is within a rural area and an established dairy farm and must be considered with regard for environmental, economic, social and cultural values. There is an existing effluent storage pond that will ensure adverse effects on the environment are avoided, remedied, or mitigated.

Relevant provisions of the relevant regional plan objectives, polices and rules (Section104(1)(b)(v))

The objectives and policies of the Regional Water Plan that are relevant to this application have been grouped according to topic:

- **Water quality:**

Policy A4	When considering an application for discharge the consent authority must have regard to: - The extent to which the discharge would avoid contamination that will have an adverse effect on the life-supporting capacity of freshwater, and on the health of people - Any more than minor adverse effect resulting from the discharge would be avoided
Policy 3	Allow no discharges to surface water bodies that will result in a reduction in water quality
Policy 13	Avoid the point source discharge of raw sewage, foul water and untreated agricultural effluent to water
Policy 25	Adverse effects arising from point and non-point source discharges

Policy 26 Avoid adverse effects on groundwater quality and quantity arising from bores and wells

Policy 42 Avoid adverse effects on water quality associated with the application of farm dairy effluent to land by matching farm dairy effluent management to receiving environment risk

Policy 7 Prefer discharge to land

- **Water quantity**

Policy B7 Consent authority must have regard to:
- The extent to which the change would adversely affect safeguarding the life-supporting capacity of freshwater.
- Any adverse effect resulting from the change would be avoided

Policy 21 Ensure the rate of abstraction and abstraction volumes specified on water permits to take and use water are no more than reasonable for the intended end use

Policy 22 Require, where appropriate, the installation of water measuring devices on all new permits to take and use water

Policy 28 Manage abstraction of groundwater to avoid significant adverse effects on:
Long term aquifer storage volumes
Existing water users
Surface water flows and aquatic ecosystems and habitats
Groundwater quality

Policy 30 Groundwater abstraction
Recognise the different characteristics of different aquifer types
Provide for level of permitted abstraction, primary allocation for consented abstraction and use, and supplementary allocation for consented water abstraction and use
Require water abstraction applications to include relevant information for the associated risk of adverse effects
Impose monitoring on groundwater resource consents that correspond to the environmental risk
Where monitoring shows significant adverse effects, mitigate those effects

- **Land and soil health**

Policy 31A Match the level of management that is required for discharges of contaminants onto or into land to the level of environment risk posed

Policy 31C Manage discharge of contaminants onto land or into land to avoid, remedy or mitigate adverse effects

- **Cultural considerations**

Policy 1.A Take iwi management plans into account

Comment

Policy 13: The farm practices that are in place manage the discharges to land and water so that water quality and health of humans, domestic animals and aquatic life is protected. At South Dairy, these practices include nutrient budgets, soil testing, appropriate effluent storage, buffer zones, lane locations and others.

Policy 21 seeks to ensure that the rate of abstraction and abstraction volumes specified on water permits to take and use water are no more than reasonable for the intended end use.

Policy 22 requires the installation of a water measuring device on all new permits to take and use water. As part of conditions of consent, Council will require the applicant to continue providing water meter readings from the meter on the bore.

The application is consistent with Policy 28 which seeks to manage groundwater abstraction to avoid significant adverse effect.

Considering policy 42: The application of FDE will only occur when a soil moisture deficit exists. The normal application rate will be low – 5mm of irrigation water which includes 0.5mm of effluent. In the area that cannot be reached by the irrigators, up to 5mm of effluent will be applied by slurry tanker. This has been planned and described in more detail in the supplied documentation. The local moisture levels will be assessed based on the monitoring site at Tussock Creek.

Consideration of the term of consent is addressed under Policy 43. Policy 43 matches consent duration to the level of environmental risk associated with the activity. Where it is likely that a resource consent will be reapproved in future, the consent duration represents the period that the Council considers the existing conditions will be effective to manage the adverse effects of the activity.

Overall, the proposed activities comply with the above policies. The applicant has proposed mitigation measures for potential adverse effects on the environment arising from the proposed activities. Any other potential adverse will be mitigated through consent conditions, providing the applicant adhere to these.

Relevant provisions of the relevant regional plan objectives, polices and rules (Section104(1)(b)(v))

The objectives and policies of the proposed Southland Water and Land Plan that are relevant to this application have been grouped according to topic:

- **Water quality:**

Objective 1	Integrated management of land and water
Objective 2	Water and land recognized as enabler of wellbeing
Objective 3	Inherent health
Objective 4	Tangata Whenua values and interest
Objective 6	No reduction in the quality of freshwater
Objective 8	Water quality to meet Drinking-Water Standards
Objective 9	Quality of freshwater is managed
Objective 18	All activities operate at good management practice.
Policy 4 – 12	Physiographic zones, avoid, remedy or mitigate

Policy 13	Manage land use activities and discharges
Policy 14	Prefer discharge to land
Policy 15	Maintain and improve water quality
Policy 16	Minimising the environmental effects from farming activities
Policy 17	Avoid adverse effects on water quality Manage effluent systems Maintain and operate effluent systems Avoiding surface run-off/overland flow Avoiding discharge of untreated agricultural effluent to water

- **Water quantity**

Objective 7	Avoidance of over allocation
Objective 11	Water is allocated and used efficiently
Objective 12	Ground water levels and minimum surface water levels are maintained
Policy 20	Manage the taking, abstraction, use of ground water
Policy 21	Manage the allocation of surface and groundwater
Policy 22	Managing the effects of surface and groundwater abstraction
Policy 23	Manage stream depletion effects resulting from ground water takes

Comment

Overall, the proposed activities comply with the above objectives and policies. The applicant has proposed mitigation measures for potential adverse effects on the environment arising from the proposed activities. Any other potential adverse will be mitigated through consent conditions, providing the applicant adhere to these.

With specific comment to Policies 15, 16 and 17:

Policy 15 & 16:
The overall result of this application will be maintained and improved water quality in the groundwater below, and surface water on the farm. In this application, the current nitrate levels on the farm have been discussed, as have the water quality measures at various surface water SOE locations. The proposal including the overall low levels of aerial effluent disposal are expected to further improve water quality of the receiving environment.

In terms of these two policies, the intensity of the overall land use has reduced, good practices are in place, and new mitigation measures have been proposed.

Policy 17: The evidence provided in the application of farm infrastructure, future plans and management practices all outline the steps in place to avoid adverse effects on water quality.

The applicant has proposed mitigation measures for potential adverse effects on the environment arising from the proposed activities, including observing FDE buffer zones where there are multiple risk factors. Any other potential adverse will be mitigated through consent conditions, providing the applicant adhere to these.

Any other matters considered relevant and reasonably necessary to determine the application (Section104(1))

The following policies in Te Tangi a Tauria (iwi management plan) are of particular relevance to this application:

Policy 3.5.1(3)	Discharge of FDE must always require a consent
Policy 3.5.1(4)	Sustain and safeguard the life-supporting capacity of soils
Policy 3.5.1(5)	Avoid using high-risk soils for irrigation
Policy 3.5.1(6)	Oppose discharge of FDE to water
Policy 3.5.1(8)	Require best practice for land application for managing FDE
Policy 3.5.1(11)	Avoid surface run-off, ponding or contamination of water resulting from the application of FDE to pasture
Policy 3.5.1(13)	require buffer zones between discharge areas and waterways
Policy 3.5.1(14)	require a buffer distance between discharge areas and bores of at least 100m
Policy 3.5.1(15)	All spray drift as a product of irrigation of effluent must be managed and contained within the boundaries of the consent area
Policy 3.5.8(1)	Accidental Discovery Protocol
Policy 3.5.11(15)	Avoid the use of rivers as a receiving environment for the discharge of contaminates
Policy 3.5.11(17	Ensure activities in upper catchments have no adverse effects on mahinga kai, water quality and water quantity in lower catchments
Policy 3.5.13(4)	Avoid compromising water quality as a result of water abstraction
Policy 3.5.13(5)	Avoid water as a receiving environment for discharge of contaminates
Policy 3.5.13(6)	Avoid impacts on water as a result of inappropriate discharge to land activities
Policy 3.5.13(11)	Require monitoring of discharge permits to detect non-compliance with consent conditions
Policy 3.5.14(4)	Preference to bore takes rather than surface takes
Policy 3.5.14(11)	Avoid excessive drawdown of aquifer levels as a result of groundwater abstraction
Policy 3.5.14(16)	Encourage the installation and use of water meters
Policy 3.5.14(17)	Advocate for duration not exceeding 25 years

Provided the applicant adheres to consent conditions, the adverse effects of the proposed activities should be no more than minor, and will comply with the above policies.

The value of investment in the existing dairy farm is very high.

4.0 Notification

Written approvals

The farm has now included a lease block that was used more as a run off block than part of the milking platform. The effluent discharge area will increase in size to cover most of the farm but will retain all buffer distances to boundaries, neighbouring houses and waterways. No written approvals have been sought. The small existing pond will be decommissioned and a new pond constructed. The changes to the farming activity will not be noticed by any neighbours or passersby.

5.0 Receiving Environment

5.1 Soils

The Southland Topoclimate maps have been used to determine the soils located on the farm. There are four soils on the farm. They are

Vulnerability Factors

Soil name	Structural compaction	Nutrient leaching	Waterlogging
Pukemutu	severe	slight	severe
Edendale	slight	moderate	slight
Waianiwa	moderate	moderate	moderate
Northope	severe	moderate	moderate

Pukemutu Soils

Pukemutu soils have a moderately deep potential rooting depth that is severely restricted by the fragipan. The soils are poorly drained with very slow permeability. They are high risk soils with limited versatility.

Edendale Soils

Edendale soils have a deep rooting depth and high plant-available water, meaning there is no significant physical barrier to root growth. The soils are well drained but the compact subsoil is slowly permeable, and may cause short-term waterlogging after heavy rainfall. They are low risk soils with high soil versatility.

Waianiwa Soils

Waianiwa soils have moderately deep rooting depth that is restricted by the fragipan at 60-90cm depth. The soils typically have moderately high to high plant available water. The soils are imperfectly drained with slow permeability through the fragipan. They are high risk soils with moderate soil versatility.

Northope Soils

Northope soils have no rooting barrier, but have high bulk density that limits the degree of subsoil root growth. Aeration is limited for parts of the year. They are high risk soils with moderate versatility.

The soils are classified A - artificial drainage or coarse soil structure

5.2 Water

Two drains originate in the farm and join tributaries of the Makarewa and Oreti Rivers. Another originates on a neighbouring property. These drains are channelized with a clay bed and are impacted by drain cleaning activities. The drains have been modified with straightening and shortening.

An additional stream flows across the north-west of the property. On this farm all areas are fenced with culvert crossings and very well vegetated with the drain flowing to the Oreti mainly planted.

The flow across the farm is generally from north east to south west or north to south.

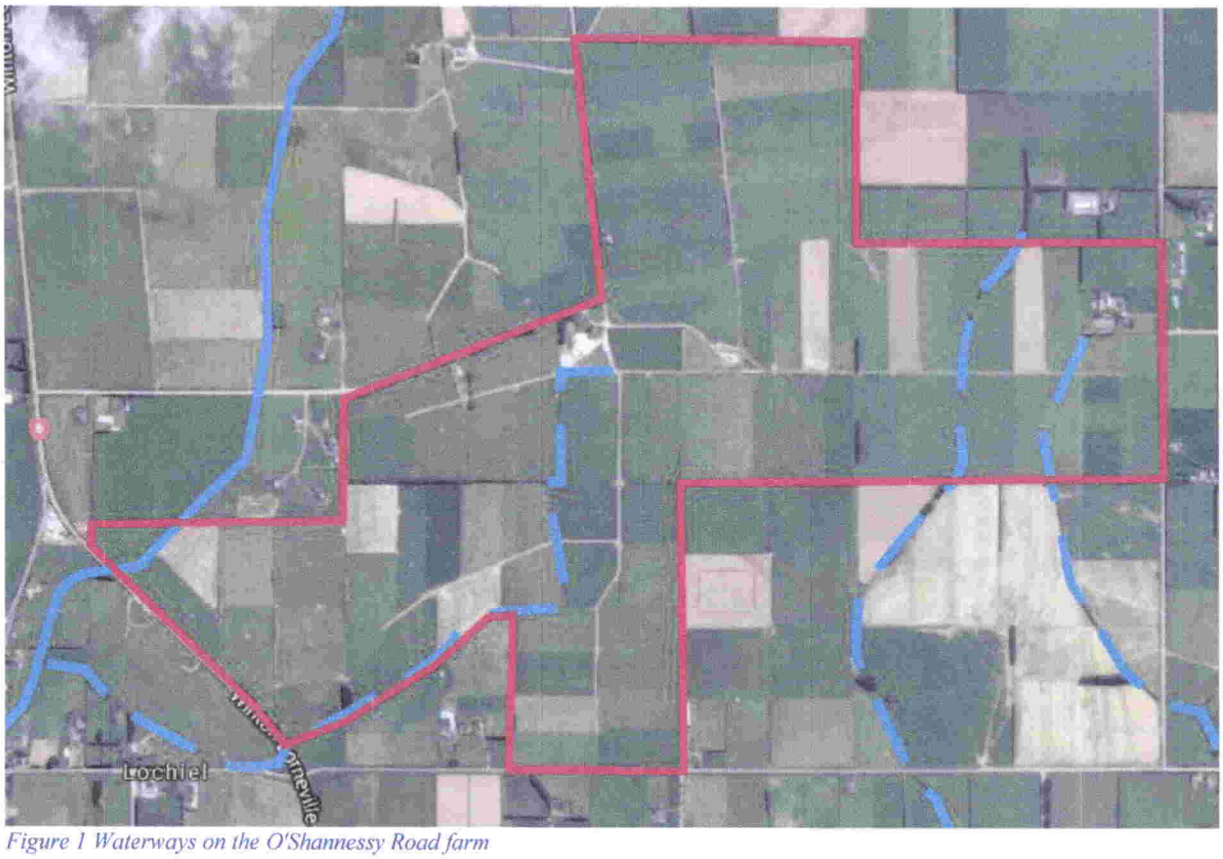


Figure 1 Waterways on the O'Shannessy Road farm

The Makarewa River runs into the Oreti River downstream of Wallacetown and finally into the New River Estuary at Invercargill.

Waterway details

The longest section of intermittent channel starts about 100m south of the house on O'Shannessy Road. This heads south for approximately 650m before heading southwest along the boundary. It exits the property at the Winton Lorneville Highway as shown in Figure 2 below.

The stream on the western section of the property has been flowing south for more than 6km when it reaches the property. Both this stream and the previous channel drain meet just north of Lochiel and then flow for another 13km before reaching the Oreti River just north of Branxholme.

The other two channels on the east side of the property flow intermittently during the winter and periods of high rainfall. The channel that starts at the pond on the neighboring property runs for approximately 700m, and the other for 450m, both in a north south direction. These join about 7.5km south of the property and travel for another 5km before reaching the Makarewa River.

Photos

Figure 2 Drain facing north east from Winton Lorneville Highway (Google Earth, 2017)

Figure 3 Drain looking north west from Winton Lorneville Highway (Google Earth, 2017)

Context, catchment

The farm is located in the Oreti catchment, with the Oreti River running to the west boundary, and the Makarewa River to the south east.

The Oreti River begins east of the Mavora Lakes and flows for approximately 170km before discharging into the New River Estuary at Sandy Point, then finally into Foveaux Strait. The upper catchment consists of pasture on the flat areas, and native trees on the hill country.

As it flows down country it is joined after by Windley River, then Acton Stream, Cromel and Irthing Streams then heading south near Lumsden. It is joined by Bog Burn Winton Streams, Terrace Creek and then the Makarewa River about 20km south of the property boundary.

The Makarewa River begins in the Hokonui Hills flowing for about 60km before meeting the Oreti River. The upper catchment consists of native forest and tussock pastures.

As the Makarewa River flows down country, it is joined by Otapiri Stream, Hedgehope Stream, Tussock Creek and Gold Creek before meeting the tributary from the farm and then the Oreti River.

The Invercargill water intake comes from the Oreti River just south of the point where the western channels from the farm enter the Oreti at Branxholme, but the impacts to the city's water supply are considered less than minor.

Water quality monitoring

There are no monitoring sites upstream of the property. The closest monitoring sites downstream are on the Oreti River at Wallacetown, and the Makarewa River at Wallacetown. These monitoring sites are shown below, with their proximity to the farm. The neighbouring site at Winton is also shown for comparison purposes.

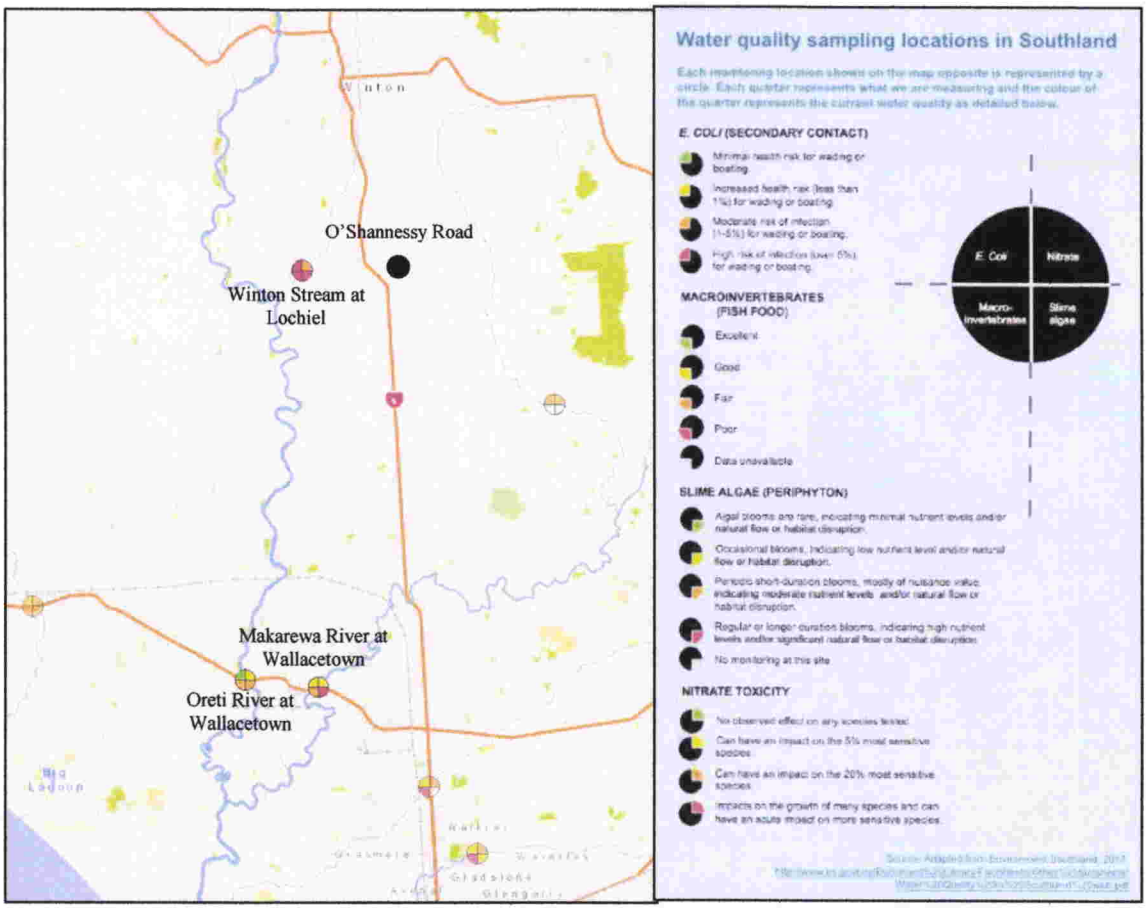


Figure 4 Water Quality (NOF) monitoring sites downstream and proximate to the O'Shannassey Road farm.

The figure above shows both sites have moderate levels of nitrate toxicity, impacting 5% of the most sensitive species, and macroinvertebrate levels are fair at both sites.

On the Oreti River E. coli levels pose a minimal health risk, and the Makarewa River has a slightly higher but minimal risk of infection (less than 1%) for wading or boating. Observed slime algae levels are poor at both sites, with periodic short-duration blooms at this point on the Oreti River, but regular and longer duration blooms on the Makarewa indicating moderate to high nutrient levels in both rivers.

A summary of the water quality in both watercourses are compared against all other rivers nationally, as well as other lowland rural sites.

Parameter	All NZ sites	All lowland rural sites	5 year trend	10 year trend
Makarewa River at Wallacetown				
E. coli	Worst 25%	Worst 25%	Indeterminate	Indeterminate
Clarity (Black disc)	Worst 25%	Worst 25%	N/A	N/A
Nitrogen (TN)	Worst 25%	Worst 25%	Indeterminate	Indeterminate
Phosphorus (TP)	Worst 25%	Worst 25%	Indeterminate	Indeterminate
Oreti River at Wallacetown				
E. coli	*This data unavailable from LAWA*			
Clarity (Black disc)				
Nitrogen (TN)				

Phosphorus (TP)				

These figures show that the river has low quality relative to other similar lowland rural sites, as well as the majority of other NZ rivers. In spite of this, there are some isolated improvements in water quality such as ammoniacal nitrogen (generally sourced from human and animal waste) which has shown an improvement in the trend over the last 10 years (LAWA, 2017a).

E. coli numbers much lower in the lower Oreti River, with recent sampling showing that microbe levels are generally at a safe level for swimming (LAWA, 2017a)[1], with a median of 76 mpn/100ml. These are significantly lower and safer than the median value of 800 mpn/100ml at Bog Burn between 2006 and 2014 (LAWA, 2017b)[2].

Water flow

The water flow is gauged at two monitoring sites close to this farm, and the hydrology statistics are published on the Environment Southland website. One monitoring site is on the Oreti River at Wallacetown, and the other on the Makarewa River at Counsell Road.

The Oreti River has a mean flow of 40.6 m^3/s, a median flow of 28.2m^3/s, a minimum recorded flow of 1.6m^3/s. The highest recorded flow is under review at this site, but at the Lumsden cableway the maximum recorded flow of 1158m^3/s.

The Makarewa River has a mean flow of 15.7 m^3/s, a median flow of 7.7m^3/s, a minimum recorded flow of 0.5m^3/s. The highest recorded flow is 726 m^3/s.

Groundwater

The property spans both the Lower Oreti and Makarewa Groundwater Zones. Groundwater underlying the farm has two nitrate levels as classified by Environment Southland's online data and mapping service. These are 75% or ~190ha of minor to moderate land use impacts (1.0 – 3.5 mg/l) and 25% or ~65ha of moderate to high land use impacts (3.5 -8.5 mg/l).

The average recharge rate from the property is 2,521m3 per day, so the take is 3.6% of the recharge.

Council compliance monitoring

Environment Southland's science team has supplied the following ground water quality data. Based on measurement of water quality at bores within a 2km radius of the farm's groundwater take, the available data is consistent with nitrate levels that represent minor to moderate land use impacts. This is shown in the figure that follows.

[1] https://www.lawa.org.nz/explore-data/southland-region/river-quality/oreti-river/oreti-river-at-wallacetown/ *Summer Season E. coli sampling* (1 Dec 16 to 16 Mar 17)

[2] https://www.lawa.org.nz/explore-data/southland-region/river-quality/oreti-river/bog-burn-ds-hundred-line-road/#download-data

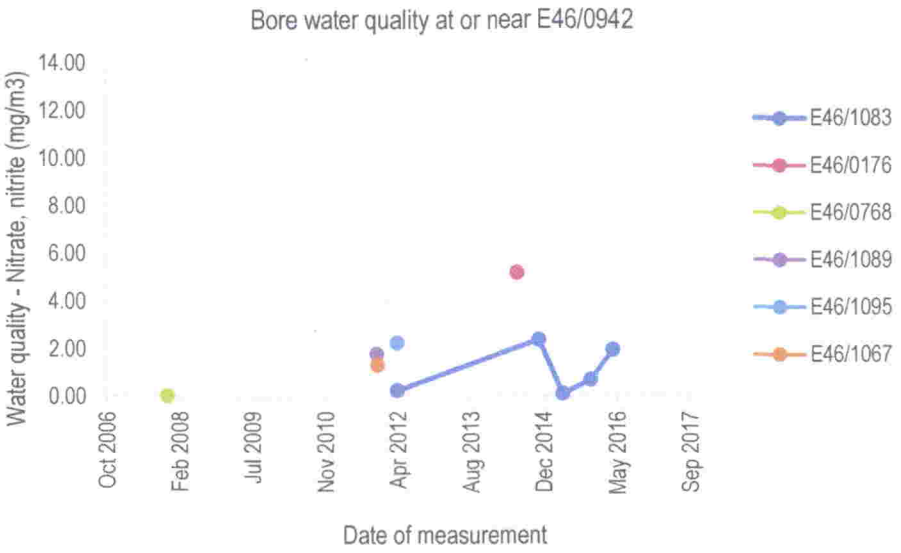
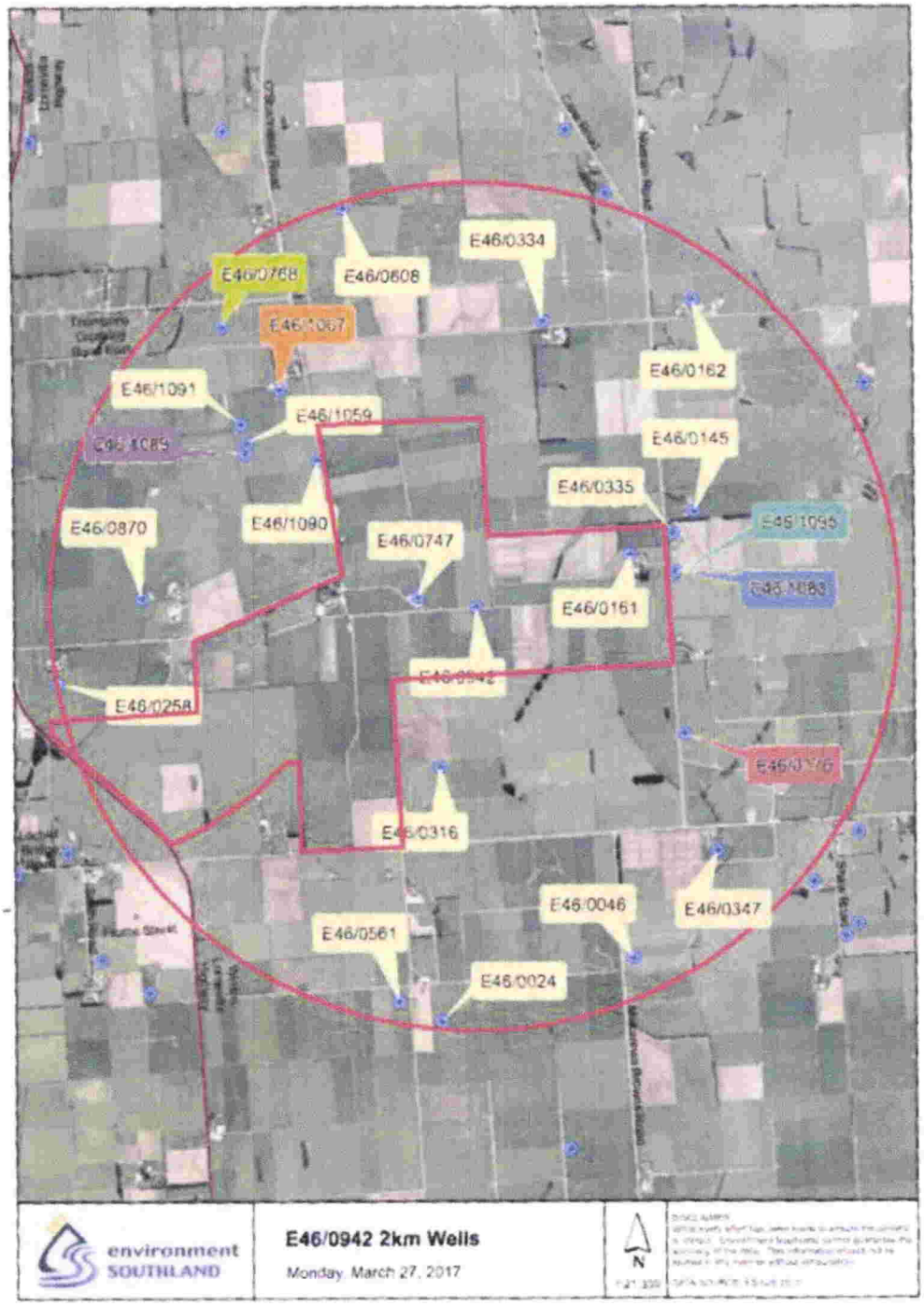


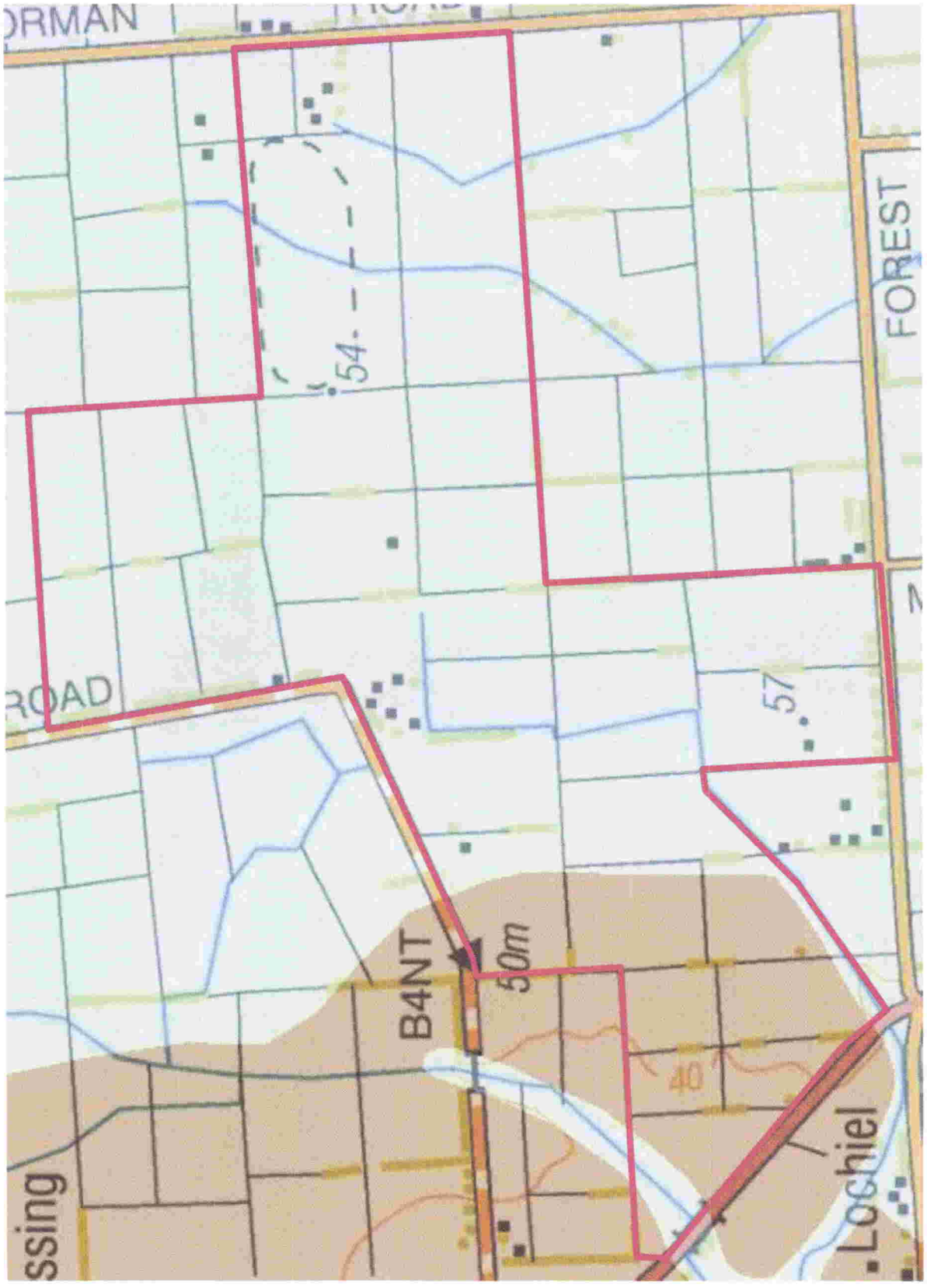
Figure 5 Water quality within a 2km radius of the farms proposed ground water take (E46/0942)



E. coli readings at the site at vary, particularly for the bore E46/1083 which is directly adjacent to the eastern boundary of the farm. In the last four years, two bore measurements have returned results of more than 1 mpn /100ml. These have been 64 in 2014 and 23 in 2016. This suggests that groundwater may have been contaminated by effluent near that bore location.

The effluent disposal plan will include the mandatory 100m buffer zone from the bores, and in particular the E46/1090, E46/0335, E46/0145 and E45/1083 that are close to the farm boundary.

5.3 Physiographics



Grey Gleyed
Brown Oxidising

Gleyed – artificial drainage

Protect soil structure, particularly in gullies	Avoid pugging pastures and repair bare areas Using along the contour cultivation Keep cultivation at correct distances from riparian areas
Reducing phosphorus use and loss	Keep Olsen P levels at optimum or less Maintain buffer zones
Reduce the accumulation of surplus nitrogen in the soil particularly during autumn and winter	Reduce use of N in autumn and use silage or pro-gibb Wintering stock off over winter Use small applications of N as pasture requires Re-sow bare or pugged areas of soil
Avoid preferential flow of effluent through drains	Only irrigate when there is sufficient soil moisture deficit Apply effluent at low rates Have sufficient effluent storage
Capture contaminants at drainage Outflows	Look at possible locations of wetlands Identify critical source areas Review riparian areas and increase if necessary

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Capture contaminants at drainage Outflows	Look at possible locations of wetlands Identify critical source areas Review riparian areas and increase if necessary

5.4 Topography

The farm is generally flat with some undulating slopes but less than 7 degrees to the south west lease area.

6.0 Proposal Details

The discharge renewal applied for is for 750 cows increased from 599 with an increased land area from 199.58 to 250.55. The stocking rate on the existing farm will remain the same at 3 cows/ha. All effluent from the shed and yard flows by gravity to a stone trap to the west of the shed and then by gravity to the pump sump. The solids from the stone trap are placed in a bunker with a weeping wall where any liquid flows to the pump sump and then pumped to the new storage pond.

At present there is a small storage pond adjacent to the pump sump which can hold about 100m3 of effluent. Other effluent collection areas include two feed pads and a calving pad but all these areas will be used as stand-off/feed/calving and wintering areas to keep stock of pasture to reduce damage and phosphorus loss. The feed pads will scraped and solids stored at the end of the pads and the liquid will drop into a pump sump and be pumped to the storage pond.

The calving pad will be on a drained clay base where any liquid will flow to a pump sump and then pumped to the storage pond. The calving pad will not be able to be diverted but all other concrete areas will be diverted when aver possible. When the effluent flows to the pump sump and if soil moisture levels and weather forecast is suitable, effluent will be pumped to the discharge area and irrigated by a Briggs 15 irrigator or a new Cobra rain gun.

A slurry tanker or umbilical system will be used to take effluent to the areas that do not currently do not have underground effluent lines. If ground conditions are not suitable then effluent is stored in a 3,060m3 storage pond which will be constructed. Until it is constructed the existing pump sump and small storage pond will be used. Effluent from the storage pond will be pumped back to the pump sump to irrigate out to the discharge area or pick up at the pond by slurry tanker or umbilical.

The application is for an increase of the discharge area within the increased farm boundary to cover the farm except buffer distances. The intensity of the operation is decreasing with the farm area staying the same with reduced cow numbers. The farm will need to prepare a management plan and parts of this Appendix N are included in the application.

6.1 Effluent

Discharge Permits Details:		
Current permit specifies cow numbers? How many?	Yes - 599	
Proposed cow numbers	750	
Stocking rate (cows/ha)	3.0 this remains the same	
Winter milking	No	
Stand-off/feed/calving/wintering shed	Yes	
Area (m)	NA	
Covered	No	
Other sources of effluent	None	
Effluent disposal area (ha)	43	
Effluent disposal area changing	Yes –increased by 157ha to 200ha	
Irrigation method	Cobra rain gun Slurry tanker or umbilical system	
Application rate and depth	Category A in discharge area	
Briggs 15 travelling irrigator	7mm	
Cobra rain gun	5mm at	10mm rate
Slurry tanker and umbilical	5mm depth	5mm rate

6.2 Effluent Storage

Based on the Massey Farm Dairy effluent Storage Calculator the farm requires 2,975m3 of storage. The farm will construct a 3,060m3 storage pond.

Storage currently available (m3)		100
Storage proposed (m3)		3,060m3
Effluent collection/storage liner		1.5mm HDPE
Number of days storage		As required by Massey storage calculator Dairy
Effluent Storage Calculator	90%	2,975
Storage requirement m3		2,975
Monitoring proposed		Check pond level Inspection of infrastructure at regular intervals

6.3 Water Take

Water will be taken from an existing bore which is 270m east of the dairy shed on the north side of the lane. The bore extracts water from the Makarewa Groundwater management zone.

Water Permit Details:	
Source of water	One bore
Groundwater zone	Makarewa
Aquifer type	Lowland
Rate of take (L/sec)	<2
Freshwater storage on site	Yes, 60m3 in 2 plastic tanks
Daily volume (m3/day)	90
Consistent with 120and 140 L/cow/day	120
Yearly volume (m3/year)	28,300
Daily volume (m3/day)	90
Consistent with 120 and 140 L/cow/day	Yes, 120
Mean Annual LSR (m3/year)	34,410,000
Preliminary allocation	8,600,000
Amount currently allocated	Low

7.0 Assessment of Environmental Effects/Mitigations

Overview

To supply an assessment of these effects, the relevant values are first outlined, then the modelled losses to the environment are discussed under both the current and proposed land-use scenarios and then the anticipated effects are considered. This is then summarised and our conclusions are drawn as follows.

Applicable values

Surface and ground water

Published plan	Values outlined
Regional Water Plan for Southland, 2010. **Objective 3** **(Lowland hardbed)**	To maintain and enhance the quality of surface water bodies so that the following values are protected where water quality is already suitable for them, and where water quality is currently not suitable, measurable progress is achieved towards making it suitable for them. (a) bathing, in those sites where bathing is popular; (b) trout where present, otherwise native fish; (c) stock drinking water; (d) Ngāi Tahu cultural values, including mahinga kai; (e) natural character including aesthetics.
Regional Water Plan for Southland, 2010. **Objective 8: Drinking water standard**	(a) To maintain groundwater quality in aquifers that already meet the Drinking-Water Standards for New Zealand 2000; and (b) To enhance groundwater quality in aquifers degraded by land use and discharge activities (with the exception of those aquifers where ambient water quality is naturally less than the Drinking-Water Standards for New Zealand 2000) to ensure general compliance with the Drinking-Water Standards for New Zealand 2000 by the year 2010.
Proposed Southland Water and Land Plan **Objectives 3, 6, 7, 8, 9 and 11**	(a) the mauri (inherent health) of waterbodies provide for te hauora o te tangata (health of the people), te hauora o te taiao (health of the environment) and te hauora o te wai (health of the waterbody); (b) there is no reduction in the quality of freshwater and water in estuaries and coastal lagoons; (c) avoid and reduce over-allocation (quality and quantity) of freshwater; (d) aquatic ecosystem health, life-supporting capacity, outstanding natural features and landscapes, recreational values, natural character and historic heritage values of surface water bodies and their margins are safeguarded; and, provided these values are met, water is available for instream and out-of- stream use to support the reasonable needs of people and communities to provide for their social, economic and cultural well-being; (e) water is allocated and used efficiently;

(f) the quality of water in aquifers that meet both the Drinking-Water Standards for New Zealand 2005 (revised 2008) and any freshwater objectives, including for connected surface waterbodies, established under Freshwater Management Unit processes is maintained;
(g) the quality of water in aquifers that have been degraded by land use and discharge activities (with the exception of those aquifers where ambient water quality is naturally less than the Drinking-Water Standards for New Zealand 2005 (revised 2008)) is improved.

New River Estuary

Value	Description
Areas containing significant values	The Department of Conservation has identified the area of the estuary generally eastward or upstream of a line drawn from "the spit" at the south end of the Oreti Beach, to Bombay Rock, to the point of land more or less east of that rock, as an area containing significant values (see ACSV 14-05 in Appendix 5). This is principally because the estuary is rated nationally important as a habitat for wader bird species, as well as a nationally important nursery area for numerous fish and invertebrate species, including galaxiids and toheroa.
Heritage and Archaeological Values	The Port of Invercargill jetty is registered by the New Zealand Historic Places Trust as a category II site. This site was the major port for Invercargill prior to the establishment of the port at Bluff. It was once linked to the city by a long jetty but that area has since been reclaimed. Other areas of the estuary also have significant heritage values. The coastline of Sandy Point between West's Point and Sandy Point was one of the first areas settled by Europeans in the greater Invercargill area and the site of early whaling activities. Prior to that it was the site of a Maori kaik. In the 1800s, the favoured route from Invercargill to Bluff was via the estuary and Bluff Harbour shorelines including Mokomoko Inlet where there was a hotel. There was a wharf and proposed township at Stanley Town, just east of Mokomoko Inlet. There are many archaeological sites of significance to Maori all around the non-reclaimed shoreline of the estuary, including middens and urupas. There are particular concentrations of such sites in the Sandy Point - West's Point area where the Maori village of Oue was once located, and along the south-west shoreline of Otatara and in the Omaui/Mokomoko Inlet area.
Natural Character and Landscape Values	The natural character values of the estuary are particularly high adjacent to much of the Sandy Point Domain and along the southern Otatara coastline where significant areas of either indigenous salt marsh or indigenous scrub or bush either adjoin or intertwine with the waters edge. The feeling of open space provided by the estuary is enhanced by the low relief of the adjoining land. This open space value is further enhanced by the quality of reflected light from the water areas.
Recreational and Amenity Values	The lower reaches of the Oreti River from Dunns Road to West's Point are frequently used for recreational activities, particularly boating. Trout fishing is undertaken virtually all year round, particularly by the elderly who appreciate the good vehicular access. All areas that adjoin Sandy Point Domain are popular for various recreational activities. The estuary is also very popular for "onlookers" or "get away from it all" people. It provides for such passive scenic recreational users. Given the proximity of the New River Estuary to Invercargill, it has great potential for further recreational use. In recent years, this use has declined in some areas due to water quality problems and increasing sedimentation.

Educational Values	The estuary offers a range of educational opportunities, the value of which are enhanced by its proximity to major schools. The study of estuarine ecosystems, rocky and sandy shores, intertidal areas etc, and the contribution of the estuary to the social geography of Invercargill, are frequently included in school curricula. As such, the estuary is the site of many school visits. Its birdlife and cultural history add to the educational experience it can offer. Educational activities are increasingly focusing on the negative aspects of the estuary such as the degree of modification and its water quality.
Marine Mammals and Birds	New River Estuary has a high value as a wading and waterfowl bird habitat. A total of 74 wading and waterfowl species (including migratory species from the northern hemisphere), have been recorded. These species include sandpipers, tattlers and greenshanks. Banded dotterels can migrate to Australia but generally migrate internally, as do South Island pied oyster catchers. South Island fernbirds inhabit coastal wetlands.
Ecosystems, Vegetation and Fauna Habitats	The New River Estuary is part of the Awarua Plains wetland complex, which is the most important habitat for birds in Southland. This has given international recognition to the area. The estuary provides extensive rearing and spawning habitat for marine and freshwater fish species, including native fish such as the giant kokopu, lamprey and the long finned eel. The whole estuary has value as a flounder nursery area, while many other fish species, including migratory species, use the estuary or parts of the estuary as a habitat on either a temporary or permanent basis. Along the shores are extensive maritime marshes including an excellent sequence of marsh to sand dune Totara forest, which is of national significance.

There are six principal issues for the Estuary, listed as:

- The effect of reclamation and impoundments on flushing (sedimentation) and habitat.
- The spread of Spartina and its effect on habitats and recreational values.
- Poor water quality.
- Eroding shoreline in places.
- Inappropriate access.
- The effect of noise on habitats and recreational values.

7.1 Effluent

The potential adverse effects of discharging dairy shed effluent and feed pad onto land include:

- Contamination of groundwater,
- Odour,
- Effects on soil structure and fertility, and
- Contamination of watercourses.

Good management and planning will avoid or mitigate the potential adverse effects detailed above. The discharge will have 20m buffer zones to watercourses and property boundaries. 100m buffers to the bore and 200m buffers to houses and lower application rates as detailed.

Deferred irrigation of effluent is possible because of the storage available which will ensure that there is a soil moisture deficit and this will minimise risk to tile or mole drained areas or ponding and direct runoff.

Scale of activity

There is an increased area of land in this application that will receive effluent discharge. Below is an analysis of the nutrient discharge and the effect on the receiving environment.

No overseer analysis is available with modelled inputs and outputs on the farm so two simple desktop analyses are considered for discharging the collected agricultural effluent:

1. The shed and yards will capture an average of 50l of effluent per cow per day that has an average loading of 0.33 kg TN/m3. It is understood these are the default values used by Environment Southland.
2. The shed and yards will capture an average of 74l of effluent per cow per day that has an average loading of 19.3g TN, 2.5g TP and 0.29kg TS. These values are based on the averages published for a Southland monitoring farm[3].
3. Based on the Overseer modelling of the land use, it can be estimated the proposed total nitrogen *from collected effluent* will be 4,345 kg per year, down from 7,830 kg based on a maximum number of 600 cows. The modelling indicates that the aerial loading *per hectare* will decrease from 145 kg TN/ha/yr to 55 kg TN /ha/year.

The purpose of using three scenarios is to provide a simplistic sensitivity analysis for comparing the current and proposed nutrient load calculations to give an indication of the scale and significance of effects of the effluent discharge to land.

The first two scenarios have been tested against the current consented (i.e. effluent from a maximum of 599 cows with an effluent disposal area of approximately 43 ha) and proposed activities (i.e. 750 cows with an effluent disposal area of 200 ha).

The Overseer scenario only provides whole farm outputs (of nitrogen and phosphorous) and includes other modelled farm inputs such as fertiliser. It also bases the effluent discharge area for the current consented and proposed systems as 79ha and 145ha respectively.

Scenarios A and B show that with the proposed increase in herd size, the aerial load from effluent reduces by 17%. AgResearch (2009)[4] recommends a maximum nitrogen load from effluent of 150 kg N/ha/year for the Southland region and both Scenarios A and B in Table 1 indicate that under the proposal, the disposal of effluent will account for 8 to 12% of this limit and in both cases reducing significantly. Based on these scenarios, the proposal is within recommended loading limits.

The Overseer scenario shows a significant reduction in aerial loading due to the increased discharge area.

Table 1 Estimate of total nitrogen and total phosphorous loads from dairy effluent irrigation

	Scenario A (Environment Southland)		Scenario B (Heubeck)		Scenario C (Overseer)	
	Current	Proposed	Current	Proposed	Current	Proposed

[3] Heubeck, S., Nagels, J., and Craggs, R., 2014. *Variability of effluent quality and quantity on dairy farms in New Zealand*. National Institute of Water and Atmospheric Research Ltd, p7

[4] Houlbrooke, D. J., and Monaghan, R. M., 2009. *The influence of soil drainage characteristics on contaminant leakage risk associated with the land application of farm dairy effluent*. Prepared for Environment Southland by AgResearch, Invermay, Dunedin.

Effluent load	TN (kg/yr)	2669	3341	3121	3908	7830	4345
	TP (kg/yr)			404	506	327	325
Aerial load	TN (kg/ha/yr)	62.1	16.7	72.6	19.5	145	55
	TP (kg/ha/yr)			9.4	2.53	1.3	1.3

For scenarios A and B the aerial loading figures range from 60-70kg N per hectare per year for the current activity, and will reduce to between 16-20 kg N per hectare per year. These new figures is still less than 15% of AgResearch's recommended maximum nitrogen loading from effluent. It is noted that the recommended nitrogen load threshold comprises only FDE discharge.

In terms of the phosphorous lost to land, the first two scenarios outline significant reductions per hectare – up to 74%, however due to the fencing of waterways and limited opportunity for flow to ground-water, the phosphorous is not expected to make its way into the waterways under normal circumstances. The overseer scenario does not suggest any change in phosphorous loss.

The western half of the farm drains to the Oreti River, and we expect E. coli levels to continue to pose a minimal health risk. The eastern half drains to the Makarewa River which has a slightly higher but minimal risk of infection (less than 1%) for wading or boating. Observing good management practices will limit E. coli entering the waterways under normal circumstances.

Scale of effects

To assess the potential effect of the effluent loads on water quality, consideration must be given to the nitrogen that may make its way into the groundwater, or other surface-water bodies, and the impact this will have relative to both existing levels of water quality, and the minimum level of drinking water standards.

Several guides exist to determine the quantity of nitrogen from effluent discharge that permeates through the soil into ground water. Environment Southland have on occasion referred to 0.5 of 1%, previous applications by Civil Tech have referred to technical water assessments of Karen Wilson of 3% for total nitrogen and 35% for phosphorous, and work by David Houlbrooke[5] suggests 7% could be a conservative figure for the attenuated loss of nitrogen that reaches the groundwater. While the specific values of soil leaching may vary, we will use the conservative figure of 7% for total nitrogen, and 35% for total phosphorous in the calculations below. Average drainage for this property in the Lower Oreti groundwater zone equates to 293mm per year.[6]

Table 2 Water quality (nitrate) concentrations with changes to farm activity

	Scenario A (Environment Southland)		Scenario B (Huebeck)		Scenario C (Overseer)	
	Current	Proposed	Current	Proposed	Current	Proposed

[5] Houlbrooke, D., Longhurst, B., Laurenson, S and Wilson, T. (2014). *Benchmarking N and P loss from dairy effluent derived nutrient sources*. p8

[6] Wilson S., Chanut, P., Rissmann, C., Ledgard G. (2014). *Estimating time lags for nitrate response in shallow Southland groundwater*. Environment Southland publication number 2014-03, Invercargill.

Concentration	TN (g/m3)	1.48	0.40	1.73	0.47	Range (6.1-8.4)	Range (6.5-9.2)
	TP (g/m3)			0.24	0.19		

This table suggests that concentrations of total nitrogen and phosphorous could be relatively low, while the Overseer modelling suggests some blocks may have a higher level of nitrates but still within the DWSNZ maximum acceptable value of 11.3mg/3.

Bore water quality measurements within 2km of the ground water take on this property show a typical nitrate/nitrite levels between 0 and 2mg/m3, and the current total nitrogen concentrations fall within this range.

With respect to ecological trigger levels, the first two scenario concentrations are within Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines for freshwater ecosystems based on the respective trigger values of <0.33g/m3 for total phosphorous and <0.614g/m3 for total nitrogen.

Overall the proposed changes in activity reflect a decrease of more than 70% in aerial nutrient loadings.

The water from the property drains eventually into the New River Estuary at Invercargill.

Estimates of the nitrogen loads in the Oreti catchment range between 2,900 and 4,900 tonnes per year – an average load of between 7 and 14.2 kg/ha/year as shown in the following table.

Table 3 Nitrogen loads for Oreti catchment

Oreti Catchment Nitrogen Load			
Total Load (tonnes/year)	Aerial Load (kg/ha/year)	Method	Reference
3,020	7.0	CLUES (total catchment area 4,314km2)	Wriggle (2008)[7]
3,736	10.6	River SoE data (aerial load calculated from total load and ES area of 3,510km2)	Aqualinc and ES (2014a)[8]
4,969	14.2	Land use modelling, and using ES area of 3,510km2)	Aqualinc and ES (2014b)[9]

Assuming a nitrogen attenuation of 97%, the effluent aerial loadings to water from the proposal in Table 1 equate to 0.50-0.59 kg/ha/year.

It is noted that the disposal of effluent to land will make up only a small component of nitrogen losses from the property – with urine patches expected to comprise the major component.

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[7] Wriggle Coastal Management, 2008. *Southland Coast Te Waewae Bay to the Catlins: Habitat mapping, risk assessment and monitoring recommendations.* Prepared for Environment Southland, August 2008

[8] Aqualinc and Environment Southland (2014a). *Regional scale stratification of Southland's water quality – Guidance for water and land management.* Aqualinc report C13055/02 prepared for Environment Southland

[9] Aqualinc and Environment Southland (2014b). *Assessment of farm mitigation options and land use change on catchment nutrient contamination loads in the Southland Region.* Aqualinc report C13055/04 prepared for Environment Southland

Effluent pond and infrastructure

Effluent will fall by gravity to a stone trap and concrete saucer with the effluent pump. The pond will hold 3,000m3 of effluent which is consistent with the Dairy Effluent Storage Calculator. Effluent will be applied to land at low application rates of by 4 different methods. All land is flat to undulating and less than 7 degrees.

The effluent disposal area will be 200ha. It will have 20m buffer zones to boundaries, roadsides and water courses and more than 100m buffer zone to the water intake. The area is more than is needed to meet the minimum requirements or 4ha per 100 cows, and is more than 3 times more than the 8ha per 100 cows as recommended in the Best Practice Guidelines Booklet. This will reduce the risk of flow to groundwater.

There are four soil types in the disposal area. Three are high risk soils but because the farm is mostly flat there is little chance of overland flow.

Vulnerability Factors

Soil name	Structural compaction	Nutrient leaching	Waterlogging
Pukemutu	severe	slight	severe
Edendale	slight	moderate	slight
Waianiwa	moderate	moderate	moderate
Northope	severe	moderate	moderate

7.2 Water Permit

The applicant requires an increase from the existing permit of 83,860 litres/day to 90,000 litres per day. The existing stock water on the additional area is unknown. The pump rate will remain the same at about 1.9 litres/sec from the ground water takes at 1241970E, 4873799N. The property has 45,000 litres of storage in 2 concrete tanks, which is a half day's supply. A water meter is installed at the bore to measure water to the farm.

The catchment is approximately 250ha. Lincoln Environmental estimate mean annual surface recharge in the Lower Oreti groundwater zone at 368mm/year. The total water use for the dairy farm is 90m3/day. The average recharge from the farm will be 2,521m3/day. The take is therefore 3.6% of the catchment.

There is no neighbouring bore within 500m. The instantaneous is less than 5 litres/sec therefore the average rather than the instantaneous rate of take ultimately determines the magnitude of effects.

The existing bore has been abstracting groundwater under the existing water permit. The nearest permitted bore is 500m away and there is no known historic well interference issues. Therefore I consider the potential well interference effects to be less than minor. In terms of potential stream depletion effects, the there is no surface waterbodies within 100m of the existing bore and therefore the potential of stream depletion effects are considered minor or less.

In terms of rates and volumes, the daily volume of 90,000 litres equates to a rate of 120 litres/cow/day and thus is consistent with Council's standard estimate for dairy cows. The groundwater take is therefore considered to meet the requirements of Policy 21 under the RWP for reasonable use. In terms of aquifer sustainability, the rate of take is the same. We consider the potential effects on aquifer sustainability to be less than minor.

Overall, the take should have a negligible effect on aquifer storage volumes, flow in adjacent water bodies and water availability for other users.

7.3 Dairy Farming – Land Use

There are four changes in land use that are being proposed in this consent. These are depicted in Figure 6 that follows and are outlined below.

1. The previous consent permitted FDE from up to 599 cows to be disposed on the farm over an area of 43ha with an aerial load of between 62 and 73 kg N /ha/year. This area is shaded in purple below. The same area also had a stocking rate of 3.0 cows per hectare. This proposal will lower the aerial load over this part of the farm to between 16 and 20 kg N /ha/year. There will be no change to the stocking rate.
2. The previously consented farm area shaded in yellow below is currently used for dairy, with up to 599 cows as per the permit. It will continue to be used for the same activity, at the same stocking rate of 3.0 cows per hectare. The proposal also requests the permit allows for FDE to be discharged to land, with an aerial load between 16 and 20kg N /ha/year.
3. 599 cows were previously wintered on the farming block. As part of this proposal, these cows will be wintered off the farm. This effect of this mitigation is quantified below.
4. The area shaded in white below has been used in the past six years as a run-off block, winter grazing, raising young stock and cows at various times. The area is 49 hectares and it is being leased. The intensity of land use prior to this proposal has been:
    a. 170 calves.
    b. 140 heifers that are going to calve.
    c. 8.7 ha or 17.8% winter crop (average from last five years).
    d. 200 cows grazed on the winter on fodder crop (68 days).

    This application proposes the land is used for the same purpose as the rest of the farm at the same stocking rate of 3.0 cows, and same low aerial loading of FDE between 16 and 20 kg N/ha/year. The average area used for winter crop will drop to 20ha over the total farm area, which is 8% or 3.9ha for this block.

Further information provided previously on the details of the current land use include:

The existing system has all young stock on the farm all year round. There are 170 calves, and 140 heifers that are going to calve. Another 200 cows also winter on fodder crops on the farm including the lease block. The heifers will winter on crop until they calve. The cows come back to calve on crop for up to 1 month.

With the expansion all calves will be sent off the whole farm in December and brought back as heifers ready to calve. All adult cows will also winter off. Both the heifers and cows will return and feed on grass with balage and on the calving pad if there are wet ground conditions. Up to 20ha of crop will be grown in the pasture renewal programme and up to 50% of this can be harvested in autumn to provide low protein feed or fed to springers in late spring. This will vary season to season.

This is 510 animals with the balance of the milking mob coming back onto crop in spring to calve.

Figure 6 Diagram outlining proposed land-use changes at South Dairy Farm

In the section that follows, the positive, negative, temporary, permanent, and future effects are discussed as they relate to changes in activity and the values described above.

Table 4 Assessment of proposed changes and impact on values

Proposed change in activity	Scale of effects	Impact on values
Existing 200ha farm: lift area used for effluent irrigation	Reduce aerial effluent loading from 72.6 to 19.5 kg TN /ha/yr and 9.4 to 2.5 TP kg /ha/yr. Lower discharge rates per area means grass is better able to utilise the nutrients and lower amounts of nitrogen and phosphorous leach to groundwater and risk run-off to surfacewater. The total amount of effluent applied through aerial loading will not change significantly across the Oreti or Makarewa catchments as a result of this proposed change of an increased area. The TN concentration will be between 0.4 and 0.47 g/m3, which is lower than the ANZECC trigger value for aquatic ecosystem health (0.5g/m3). The lower nitrate levels are expected to improve the overall level of dissolved nitrogen which will make the waterways more habitable to insects and fish.	Lower nutrient levels in surface- and ground-water means a positive change for bathing, stock drinking, aquatic life, natural characteristics and improved economic value through more efficient use of (natural) fertiliser. This will also result in lower total amounts of TN and TP that flow down to the New River Estuary. These are positive and permanent impacts.
Current run-off and winter grazing block: Add to dairy farm	The current total urinary N loss from the calves, heifers and wintered cows with the current land use is 16,100 kg N over the 49ha. The calculations that support this are attached as an appendix to this letter. The proposed total urinary N loss under the proposal is 21,700 kg N over the 49ha. This is an increase by 5,600 kg N. This increase will be more than offset by the mitigation to winter the 599 cows off the farm – which will take	The effects on the values of the receiving environment include: Groundwater on this block will continue to receive nitrogen as it makes it's way through the oxidising physiographic zone during periods when the pasture cannot take up all of the nutrients but the new pond will also allow the effluent to be stored and these potential

	22,000 kg N off the whole farm. Considering only the aerial effluent, loading will be 19.5kg TN /ha/yr and 2.5 TP kg/ha/yr. The TN concentration will be between 0.4 and 0.47 g/m3, which is lower than the ANZECC trigger value for aquatic ecosystem health (0.5g/m3). The new concentration that will leach to groundwater is lower than the current nitrate levels of moderate to high land use impacts (3.5-8.0mg/L) on 75% of this block of land.	losses managed. The property spans are two groundwater zones – the Makarewa and Lower Oreti. The net effect of removing the wintering cows will mean that the water quality improves in the surface water during the winter months, this is a seasonal change, but permanent. Overall the nitrogen load that discharges into the New River Estuary will also reduce, reducing nitrate levels and improving the water quality over time. This will be a permanent change. As nitrate toxicity reduces in the Oreti and Makarewa rivers, phospohorous and faecal contaminants reduce, the vegetation, habitats and ecosystem diversity will also improve.

7.4 Cumulative effects

Until such time catchment limits are set for the Southland region which balance community values for interconnected water bodies, and account for contaminant contributions from all land use types (in accordance with the requirements of the NPS-FM), it is difficult to assess where the cumulative effect threshold applies in reference to an individual activity. The details in our assessment has therefore been prepared using publicly available information assessed against the values and objectives in regional plans.

At present, the state of the receiving environment in the Lower Oreti management zone reflects both background levels of nutrients in the waterways as well as modern human activity from forestry and agriculture and other activity nearby and upstream.

As shown in Figure 7 the water quality and health of aquatic life being measured at discrete monitoring stations large covers large areas of land spanning multiple uses, and at varying intensities of stocking and fertiliser use, and with a range of mitigation measures. The monitoring shows that between Lumsden and the Oreti River at Wallacetown is that the cumulative effect of all nutrient discharges and activity results in poorer water quality because of higher nutrient levels, and lower macroinvertebrate levels. For the purposes of this application however, it is too difficult to quantify the levels of multiple nutrient sources or model the interactions with this new proposed activity.

On-farm, the cumulative effects that are most significant are the introduction of dairy cows to the property for the majority of the year. (but excluding two months over winter) and the leaching to groundwater of nitrogen in the solids and urine patches when the cows are in the paddock. While the Edendale soil and Oxidising physiographic of this new block are low-risk, care will need to be taken during periods of high rainfall and the new stand-off/feed/calving pads will assist with this.

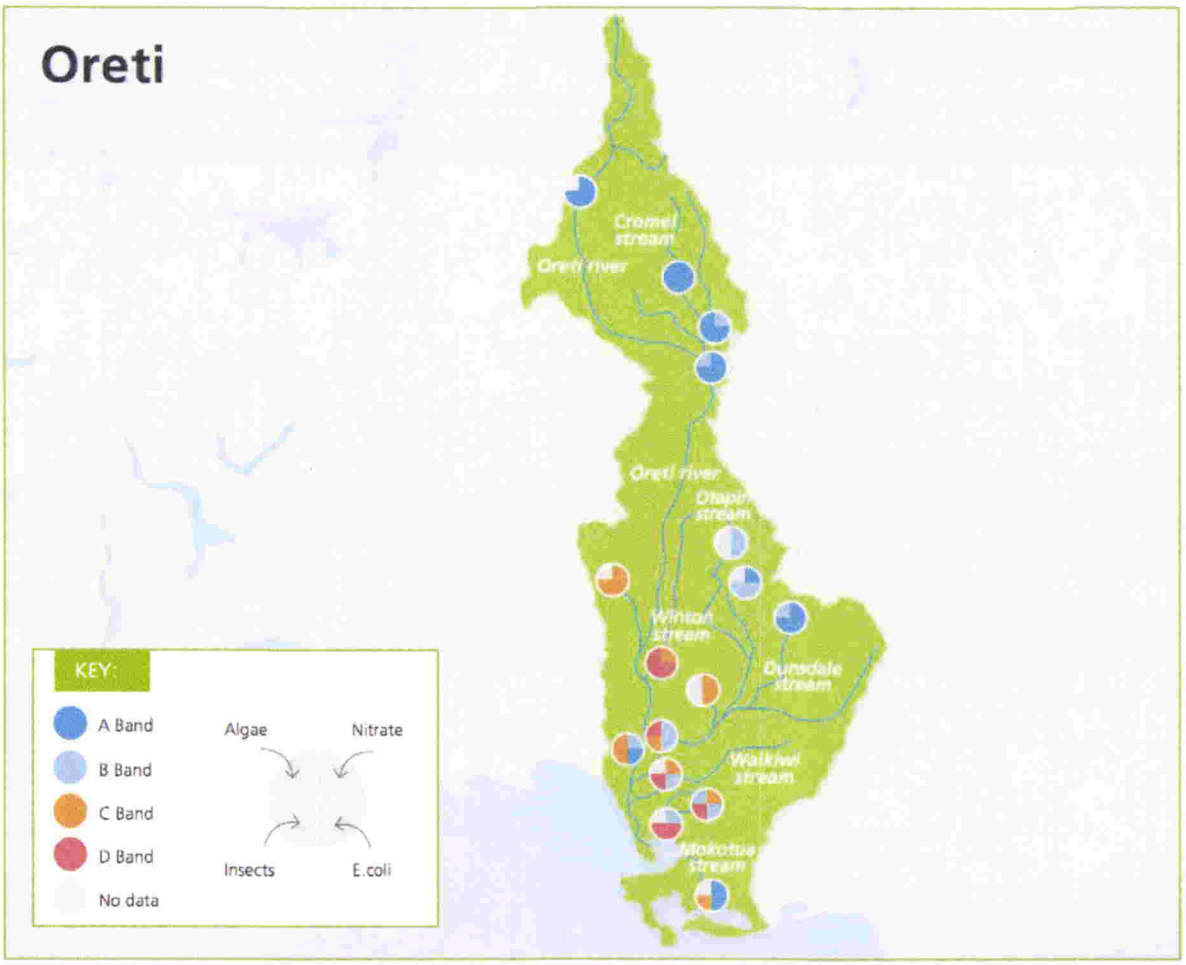


Figure 7 Water quality state and trends for Southland. Environment Southland (2016)

Physiographic Zones

As discussed in the application, the farm spans both Oxidising and Gleyed physiographics. The previous farm area is almost all Gleyed, and the proposed changes to increase the disposal area would have the positive effect of more soil contributing to the de-nitrification process. The risk with this zone is the risk of waterlogging and the potential to lose nutrients, sediment and microbes via artificial drains.

The Oxidising physiographic covers 75% of the south-west addition, and the risk is that the groundwater is susceptible to nitrate accumulation. Figure 8 below outlines the physiographic zones compared with the existing farm (yellow), proposed farm area (white) and the existing permitted discharge area (purple).

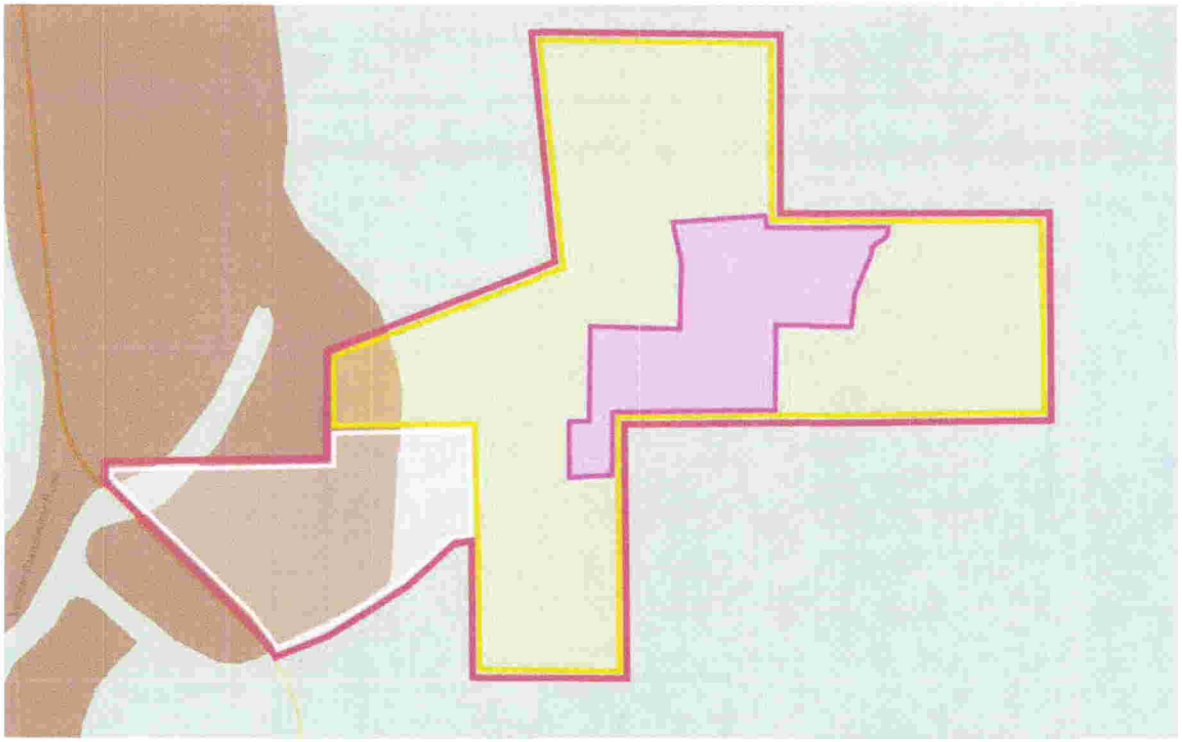


Figure 8 Physiographic zones on South Dairy farm

Recommended management practices and mitigation measures in the zones on the farm

Gleyed – artificial drainage

Protect soil structure, particularly in gullies	Avoid pugging pastures and repair bare areas Using along the contour cultivation Keep cultivation at correct distances from riparian areas
Reducing phosphorus use and loss	Keep Olsen P levels at optimum or less Maintain buffer zones
Reduce the accumulation of surplus nitrogen in the soil particularly during autumn and winter	Reduce use of N in autumn and use silage or pro-gibb Wintering stock off over winter Use small applications of N as pasture requires Re-sow bare or pugged areas of soil
Avoid preferential flow of effluent through drains	Only irrigate when there is sufficient soil moisture deficit Apply effluent at low rates Have sufficient effluent storage
Capture contaminants at drainage Outflows	Look at possible locations of wetlands Identify critical source areas Review riparian areas and increase if necessary

Oxidising – artificial drainage

Protect soil structure, particularly in gullies	Avoid pugging pastures and repair bare areas Using along the contour cultivation Keep cultivation at correct distances from riparian areas

Reducing phosphorus use and loss	Keep Olsen P levels at optimum or less Maintain buffer zones
Reduce the accumulation of surplus nitrogen in the soil particularly during autumn and winter	Reduce use of N in autumn and use silage or pro-gibb Wintering stock off over winter Use small applications of N as pasture requires Re-sow bare or pugged areas of soil
Avoid preferential flow of effluent through drains	Only irrigate when there is sufficient soil moisture deficit Apply effluent at low rates Have sufficient effluent storage
Capture contaminants at drainage Outflows	Look at possible locations of wetlands Identify critical source areas Review riparian areas and increase if necessary

Good Management Practices

This coming season and ongoing we will implement all of the following good management practices (GMPs). The mitigation measures we will implement where it is appropriate to do so.

Table 5 South Dairy Good management practices this coming season and ongoing

Activity	Relationship to risks with physiographic zones
Nutrient management plans	Limit the use of artificial fertiliser to reduce the amount of nutrient leaching to groundwater in porous zones, or surface water where waterlogging is higher risk.
Optimum soil test P	Information that helps farm manager optimize use of fertilisers and supplements to reduce the amount of nutrient leaching to groundwater or surface water, and maintain health of cows.
Stock exclusion from streams and wetlands	Ensure there is no nutrient discharge from the herd directly into waterways, so there isn't faecal contamination, or nitrogen or phosphorous directly into the water.
Tracks and lane site away from water	Limit faecal contamination or phosphorous run-off into the waterways, and limit sediment and erosion effects from stock.
Limited N fertiliser use	Limit the use of artificial fertiliser to reduce the amount of nutrient leaching to groundwater in porous zones, or surface water where waterlogging is higher risk
Grass buffers	Limit faecal contamination or phosphorous run-off into the waterways, and limit sediment and erosion effects from stock. Grass helps with uptake of any discharge and nutrients in the root zone.
Restricted grazing of cropland, some still planted for pasture renewal	Limit high density and concentration of effluent that can flow overland where waterlogging is a risk, or through to groundwater where the zone is more porous. Also maintains soil structure where pasture may be prone to pugging and compaction.
Pugged soil resown	Ensure high ability of soil to use available nutrients and productive capacity.

Table 6 South Dairy – Appropriate mitigation measures

Activity	Relationship to risks with physiographic zones

Restricted grazing in autumn	Using high carbohydrate feeds with less pasture or silage.
Using low N feeds	The use of fodder crop maintains energy levels with lower N inputs, reducing the N outputs and losses.
Winter off stock	Reduces the risk of nutrient leaching in porous soil, phosphorous and sediment loss via overland flow during wet periods, and soil compaction.
Restricted grazing of pasture	The use of stand-off/feed/calving pad when soil conditions are wet reduces the N lost during periods when nutrients can be more easily lost to ground or surface water.
No till pasture where possible (direct drilling)	Reduces the risk of soil and sediment loss through direct drilling of grass to grass where possible.
Fertiliser in split dressings	Reduce the risk of nutrients being lost past root zone if concentrations are too high to be absorbed by pasture and crops. Also when heavy rainfall follows the dressings, the split dressings reduces the nutrients loss to ground or surface water.
Feed / standoff pads to keep cows of wet ground	Control the damage to pasture, and when effluent is applied to land through use of storage.
Calving pad rather than calving on swedes	Limit high density and concentration of effluent that can flow overland where waterlogging is a risk, or through to groundwater where the zone is more porous. Also maintains soil structure where pasture may be prone to pugging and compaction.
Low rate effluent - pulse if needed	Reduce the risk of nutrients being lost past root zone if concentrations are too high to be absorbed by pasture and crops. Also when heavy rainfall follows the dressings, the split reduces the nutrients loss to ground or surface water.

Effectiveness of mitigation measures and good management practices

The mitigation measures have been listed and outlined in previously in Table 6. The positive effects of cows no longer being wintered on the main farm has been quantified in more detail with supporting information in *Appendix 8 Scale of effects of urinary N from Heifers, Calves and Cows*.

Effects on Sources of Human Drinking Water

Invercargill takes water from the Oreti River about 11 km downstream. Any potential effects on the town's water supply resulting from the activity are likely to be negligible. The discharge is not directly to water, and buffer zones are imposed to reduce contamination of surface water. Low rates of irrigation over a large discharge area, and there is more than sufficient effluent storage to ensure that irrigation can be deferred until soil moisture conditions are suitable.

7.5 Monitoring of Effects

The groundwater bore water quality will continue to be monitored by Environment Southland, as well as the river water quality, macro invertebrate, algae and nutrient levels. The existing arrangement with Environment Southland is that they will undertake a bore water quality test bi-annually and on-charge to South Dairy, however no records of water quality measurement at E46/0942 have been supplied on request for this application.

The activities to monitor the effects on the farm include daily recording of effluent discharge to land, including the paddock, volume and moisture. There will be soil testing of each paddock each year to check nutrient levels especially Olsen P test and trace elements to ensure optimum use.

Recording the mitigation measures for the required winter crop and cultivation plans is required as part of the Management Plan detailed in Appendix N.

7.6 Alternatives considered

The main scenarios are as follows:

1. Status quo: Continue using the dairy farm as per previous permits of 599 cows on 200ha of land with minimal discharge area, and continue using the 50ha south west block as a run-off and winter-grazing block.
2. Increase effluent disposal area, but do not expand farm: Continue using the dairy farm as per previous permits of 599 cows on 200ha of land, with an increased discharge area. Continue using the 50ha south west block as a run-off and winter grazing block. Continue to keep 599 cows wintered on the farm.
3. Expand farm to 750 cows and 250ha of land, with an increased discharge area. Heifers and calves removed from 49 ha block. Take 599 cows off the main farm over winter.

We are proposing scenario 3. The other options are sub-optimal for environmental, economic or efficiency reasons. The proposed activity meets the existing standards and requirements.

7.7 Additional comments

1. Ground water availability

Water is to be taken from the existing bore which is located 260m east of the tanker track loop. The water requirements are included in the Application for Water Permit.

2. Slope

The farm is flat and undulating and all less than 7 degrees.

3. Water quality risks

The water quality will be protected by the ability to store effluent until there is sufficient soil moisture deficit to irrigate with low application rates. The stream and open drains that runs through the property are fenced and vegetated. Even though most of the soils are high risk the land is flat. The application rates are low and spread over a large area.

4. Farm dairy effluent risks

Effluent will be irrigated within the conditions set in the discharge permit. The system will also permit lower application rates than the standard design parameters. The full details of the effluent management are included in the Collected Agricultural Effluent Management Plan.

5. Soil risk/vulnerability factors

The farm has high risk soils but the farm is flat and less than 7 degrees. They have high to limited versatility. The soils were mapped in the Topoclimate series. There are many dairy farms on these soils around the area.

6. Nutrient management

The key to on-going success is to carry out soil testing regularly and re-run the nutrient budget. Eighty percent of the farm will be used to spread effluent. The aim is to spread a small amount over the discharge area each year to reduce the use of artificial fertilizer.

7. Wintering management

There may be up to 20ha of crop grown on the farm which can be used to winter some cows, grazing for springers and will be part of the pasture renewal programme. This is less than 50ha. All young replacements will be wintered off the farm.

8. Sensitive areas identification

There is one stream which runs through the property and two open drains start within the property or are not tiled in the property. These drains have intermitant flow. They have been fenced for a number of years and well vegetated. All effluent will be managed by storage and low application rates. No effluent will reach the streams. Stock management is important to reduce structural compaction of the Pukemutu and Northope soils but otherwise the soils quite versatile. The feed, stand-off and calving pads will greatly assist this.

9. Stocking rates

The stocking rate is 3.0 cows/hectare which will remain with the increased area.

10. Bridges and culverts

There is one bridge and two culverts on the farm. At the end of these there are riparian areas.

11. Farm management plans

A Collected Agricultural Effluent Management Plan is attached.

12. Stock access to water

The stream is fenced and there is no access to this water for stock. All paddocks have troughs connected to the water scheme.

13. Riparian management

The streams are fenced and well vegetated. The shed, yards and effluent storage pond are well away from any open drain. The vegetation within the open drains will tend to trap any sediment when they flow.

14. Silage management

If the farm has a silage pad, it will meet the requirements of the proposed Southland Water and Land Plan.

15. Offal disposal

Any offal pit it will meet the requirements of the proposed Southland Water and Land Plan. It will not be located closer than 50m to any water course, bore, permanent building or property boundary. It will be constructed so as to not have water run-off into it and be used for offal/dead stock only.

16. Sludge management

All effluent flows directly to the stone trap where some sludge is held and cleaned out into a concrete bunker with a weeping wall. The feed pads will have nib walls and solids will be pushed up the slope when generally dry and stored there. The liquid that weeps from the heap will flow back down the feed pad and into the pump sump.

17. Sediment management

The waterways are fenced and have vegetation cover. The feed pads and storage pond that are to be built are well away from any drain with sufficient buffer for any silt. The material to be used does not cause siltation problems.

18. Open drain clearing

Any open drain clearing will be done at appropriate times.

19. Soil disturbance/earthworks

The feed pads and storage pond that are to be built are well away from any drain with sufficient buffer for any silt to settle out.

20 Drainage development

The farm has a large number of tiles and the owners are currently developing a tile map for their Management Plan.

21. Runoff

The streams are fenced with vegetation and the farm is generally flat.

22. Shelter removal

There are several north south running shelter belts and these will be retained.

23. Dairy lane location

There are no lanes adjacent to any drains with only one culvert crossing.

24. Cultivation

Cultivation will be undertaken as part of the pasture renewal programme and includes up to 20ha of fodder crops as part of that rotation and since the farm is flat will easily comply with cultivation rules in the pSWLP.

7.8 Summary of assessment of environmental effects

As outlined in Table 4 above, each of the activities, their effects and the follow-on impact on the values has been assessed. The mitigation of removing 599 cows from the main farm over winter will on its own mitigate more than the increased N loss on the additional block. This suggests the negative effects of the changes will be no more than minor, and with positive resulting benefits.

The following practises will monitor the mitigations. Collected Agricultural Effluent Management Plan – record all location and depth of effluent. Soil testing – confirm optimum use of fertiliser. Nutrient Budget – plan fertiliser use. Farm Management Plan - all cultivation and fodder crops (not grazed in winter) planned and grown. Proof of Placement – fertilizer spreading. These will reviewed along with a record of any changes or improvements that need to be undertaken.

With particular reference to Policy 16, the proposed changes support the intent to limit further increase of farming activity "where the effects on the quality of water … cannot be avoided or fully mitigated". In the case of this proposal, the overall changes will reduce the overall intensity of the farming operation, with the overall effect of improved water quality.

In terms of Rule 22, this document and the original application provides further detail on the management plan, references several publications to support the scale of effects of the operations, and outlines good management practices and mitigation measures that will further minimise unwanted discharges to the receiving environment.

8.0 Consultation

The farm has increased in size and the additional area was used for dairy grazing and there will be no noticeable change to the farming activity. No consultation has been undertaken. The change to the farming activity is to increase cow numbers from 599 to 750 cows with a corresponding increase in land area. The discharge area has increased by 157ha. The farm is fully developed and the increased infrastructure is to manage the effluent and to keep cows off wet soils. There are no special circumstances with the discharge of farm dairy effluent.

9.0 Conclusion

The farm is an on-going operation with increased cow numbers but with larger discharge area will have a much-reduced aerial effluent loading. With the flat farm, good riparian vegetation collected effluent storage and low application rates there is little risk to water quality.

Appendix 1 Collected Agricultural Effluent Management Plan

This plan has been written for all employees, contract milkers and share milkers of South Dairy Ltd, and all others associated with managing the farm and dairy effluent system.

A: OBJECTIVE

"As good environmental stewards and responsible citizens, manage the farm dairy effluent system so as to take all practical steps to avoid contamination of ground and surface water, whilst optimizing the of the productive benefits of the effluent asset".

Key strategies to achieve this objective:

- Prepare, implement and monitor a nutrient budget by the Overseer programme to maximize the returns from the resource particularly N, P & K.
- Carry out regular soil tests.
- Subject to soil moisture and weather conditions, irrigate at every practical opportunity to keep the storage pond as empty as possible.
- Ensure that all the staff operating the system are trained and competent, and are aware of the need to continuously monitor the effluent handling system and the farms drainage networks.
- Document system operational details to ensure the system is monitored, to maximize re-use of the nutrient and minimize risk.
- Ensure by regular and programmed checks that the supporting effluent infrastructure is in good condition, is inspected regularly and maintained under a preventative maintenance schedule.
- Ensure by regular inspection that the farms drainage does not contain any obvious signs of dairy effluent contamination.
- Remaining alert to new and emerging technologies that can be incorporated into the system to improve performance or reduce environmental risk.
-

B: DESCRIPTION OF COLLECTED AGRICULTURAL EFFLUENT DISPOSAL SYSTEM

COLLECTION AND IRRIGATION SYSTEM

I. All effluent from the farm dairy and yard areas will flow to the stone trap and pump sump. All effluent from the calving pad will flow to the pump sump. The effluent will be pumped to the discharge area if the soil moisture levels are suitable. If not it will be pumped to the storage tanks.
II. All effluent from the feed pad will fall to a pump sump and be transferred to the storage pond
III. The effluent will be pumped to the discharge area when the soil moisture level is suitable by traveling irrigator, rain gun or picked up by a slurry tanker or umbilical system.

Drainage Monitoring

a: Tile Map

1. Refer to the farm discharge map.
2. There is a tile network.
3. If tiles are installed then the tile location should be added to the map.
4. It is to be updated if paddocks are moled.

b: Tile end marks

I. Any tile outfalls are to be marked on the watercourse banks with a painted stake.

Volumes

a: Generated

I. Total effluent generated per day should be around 37m3 per day. 750 cows x 50 l/cow per day. This will be from the dairy shed and yards.
II. The Massey Pond Calculator has been used to calculate total storage required.
III. A report generated from the pond calculator showing input data has been supplied.

b: Pumping

A new pump will deliver approximately 20m3/hour.

I. The total pumping time per season will be approximately 500 hours per season.
II. Or about 15 hours per week.
III. Each day's accumulated effluent will take approximately 1.8 hour continuous pumping to irrigate.
IV. The slurry tanker will operate as required.
V. The umbilical system will operate if the pond needs to be lowered quickly.

c: Pulsing and Automation

The pumping system and irrigators are fitted with a "failsafe" system. The application rate per hour and total depth of application can be set on the irrigator to suit soil moisture conditions and the slurry tanker can operate at very low rates if required.

C: SYSTEM MANAGEMENT

1. PERSON IN CHARGE

The person in charge of the effluent management system will be Mr Dean Alexander or the farm manager who will live on site and will have overall control.

2. SYSTEM TRAINING

A: Training

All staff will be given initial training on the operation of the system and when any new system is commissioned. All the new staff will be trained in the operation of the system as and when employed.

Details to be recorded in a staff training log.

B: Resources

Operational sheets and copies are to be held in operational manuals in the cow shed.

3. APPLICATION RATE

The maximum application rate is pre-set by the cam setting. Assuming that the same setting is always used, the application rate will only very slightly according to the pumping pressure based on distance to the irrigator.

The traveling irrigator and rain gun shall be set to operate at no more than 10mm.

The slurry tanker and umbilical shall be set at a maximum of 5mm per application.

Any extension of the mainline network should be tested in say three places to understand what the delivery is at these points. In the interim the slurry tanker and umbilical system can spread on the additional area.

4. DEPTH OF APPLICATION

The farm moisture levels will be compared to the Tussock Creek monitoring site in order to determine whether to irrigate and the appropriate application depth of effluent to be applied.

The appropriate time to pump to achieve the correct depth of application, with the irrigator, is by the cam setting.

The irrigator will run until the pump stops or the irrigator reaches it preset travel distance.

Annual Application Depth and Fertiliser Values

With low depths of application annually to the effluent area the nutrient requirements will be much lower than the total determined by soil analysis. The fertilizer requirements will be determined annually for N, P & K content. A nutrient budget will then be completed (updated) to determine the appropriate solid fertilizer requirements. The aim will be to maximise the use of effluent and minimise the additional solid fertilizer.

Estimate of fertiliser values

Where the composition of the effluent in not known, use the following conservative figures as a guide.

1mm of irrigated effluent depth equals.

3 kg per hectare of N,
3.5 kg per hectare of K,
0.2 kg per hectare of P.

So if 10mm of effluent is irrigated onto one spot, the nutrient application will be:

30.0 kg per hectare of N,
35.0 kg per hectare of K,
2.0 kg per hectare of P.

5. PADDOCK SELECTION

Paddocks will be selected according to their moisture status and grazing management. A sequence of paddocks can be pre-planned for irrigation. Each paddock is grazed and then spelled for the required period before it can then be irrigated. Prior to irrigation a visual assessment of the soil is to be made. If paddocks are pugged or are likely to have very low infiltration rates the irrigation depth will be reduced or the paddock rescheduled for irrigation after the soil conditions have improved.

The critical factor is that paddocks should not be irrigated when, or where irrigation will result in the moisture levels exceeding Field Capacity. After this point drainage starts either by passing down through the soil profile or flowing over the ground surface (overland flow).

Tile Lines

If there are any tile ends that are not known then these will be located and marked on the tile map.

Care must be taken when irrigation is done directly over them in every instance. The farm has poorly drained soil and tiles and moles.

6. COVERAGE AREA

There shall not be any discharge of dairy shed effluent onto land within:

20 metres of any surface watercourse;
100 metres of any potable water abstraction point;
20 metres of any property boundary;
20 metres of any residential dwelling.

Dairy shed effluent shall not be discharged onto any land area that has been grazed within the previous 5 days.

Effluent should not be discharged over tiles/lines moles where the soil is at or near field capacity.

7. NUTRIENT BUDGETS

A nutrient budget will be completed annually and will be used in conjunction with soil test data to set the quality of nutrients to be applied per hectare. This will be done in conjunction with the fertiliser supplier.

8. RECORDS

As each paddock is irrigated the application depth will be recorded. This will also provide an annual record of the total depth of effluent applied.
a: Application farm map.

A farm map is to set up each year or log book is to be maintained setting out what paddocks were irrigated when, at what rate (including settings) and to what depth. This map can be used not only in any discussions with compliance authorities, but as data for use in nutrient/fertiliser application planning.

D: MONITORING MAINTENANCE AND OPERATING PROCEDURES

1. Daily

Minimise water use at the cow shed;
Check the storage and irrigation system for operating faults during and following use; evaluate the soil moisture situation and calculate the optimum method and settings for the next application.
Move the irrigator as required to ensure there is sufficient area available for the next discharge and that they are properly sited and ready to operate.
Check and record in log any tile outfalls draining from the irrigator area.
Update the effluent irrigation log with settings, location, depth and method of application.

2. Weekly

a: Storage Facilities
Check tank level.
Check inlet and outlet pipes and clear any blockages;
Check and clean grates and sumps in dairy shed and yard as required.

b: Effluent Pump, Motor and Controls
Check pump and motor, grease if required;
Check mechanical switch gear is operating efficiently;
Note and follow up any unusual noises when the pump is operating.
Check anti siphon devices for blockages.
Note operating pressure during irrigation.

c. Pipelines
Check for leaks and blockages in pipes and joiners.

3. ANNUAL MAINTENANCE

Check pumps and motors and have them serviced by qualified technician;
Assess condition of pipeline, repair and replace parts as necessary;
Update irrigation maps for new fences, tiling etc
Training of new staff.

4. END OF SEASON

Ensure the storage pond is pumped down as far as is practical.
Turn on rainwater diversion.
Drain pumps and/or set frost lamps.
Check pumps and pipes for wear and tear and perform any maintenance required.

5. BEGINNING OF SEASON

Turn off rainwater diversion.
Prime pumps and check their operation.

6. BREAKDOWNS

In the event of power failure, pump or motor breakdown.
Contact repairer immediately to assess problem;
Limit or cease water use in the dairy yard and scrape effluent where possible if the pump pond is full;
Complete repairs or install the back-up pump before the next milking, depending on the storage available.
Where necessary arrange for a back-up petrol/diesel pump.
In the event of pipe blockages:

- For underground pipes: Clear if possible or if too difficult, contact a blocked drain repairer to water blast.
- Drag hoses: open camlock joiners to locate and clear blocks in pipe section;
- If not able to clear blockages, replace the blocked section or move the irrigation lines closer to the pump.

7. GENERAL

Under no circumstances are storage facilities to be allowed to overflow;
There shall be no ponding of effluent in the discharge area;
Maximise full use of the discharge area;
There shall be no discharge of effluent to frozen or snow covered ground;
The discharge will be managed to ensure aerosoling, spray drift and odour do not travel past the property boundary.
The general state of the property is to be monitored particularly areas where environmental contamination with effluent could be a problem. This includes races and silage storage and feeding areas. Remedial action should be taken before problems arise.

8. PLAN REVIEW

Review whole effluent management plan and update by 30 April 2018.
Record irrigation areas due to any new moleing, tiling, etc.
Any developments in infrastructure – ie new/more irrigators, extensions to system, fencing changes.
Developments/targets for coming season verses the effluent plan.

E. Emergency Responses

1. STORAGE OVERFLOW

Where the storage is approaching full, and rain events of continued duration occur that could risk overflow, it is recommended that some low rate spreading with the slurry tanker be started on the lower risk soil areas. Spreading the effluent very thinly over a large area over a longer period of time is preferred to a point source leak from the pond WHICH ON THIS FARM COULD CAUSE ACROSS GROUND FLOW.

2. PONDING – (OVERLAND FLOW)

Should light ponding be detected irrigation will immediately stop. Checks should be made to ensure that there is no overland flow or ponding and any effluent stopped by bunding.

3. DRAINAGE – EFFLUENT ENTERING A WATERWAY

a: Overland flow
See ponding above
b: Discharge via a tile
See c: below
c: Effluent in open drainage
Attempt to immediately contain the contaminants by damming the drain if practical. This can be done by dumping a bale(s) of baleage or hay in the drain and pressing down with either the front end loader or tractor wheel or filling with clay.
Clay and silage wrap can often be used to help seal or form the required plug.
If possible disburse effluent with pod sets over a wide area.

4. EMERGENCY PROCEDURES

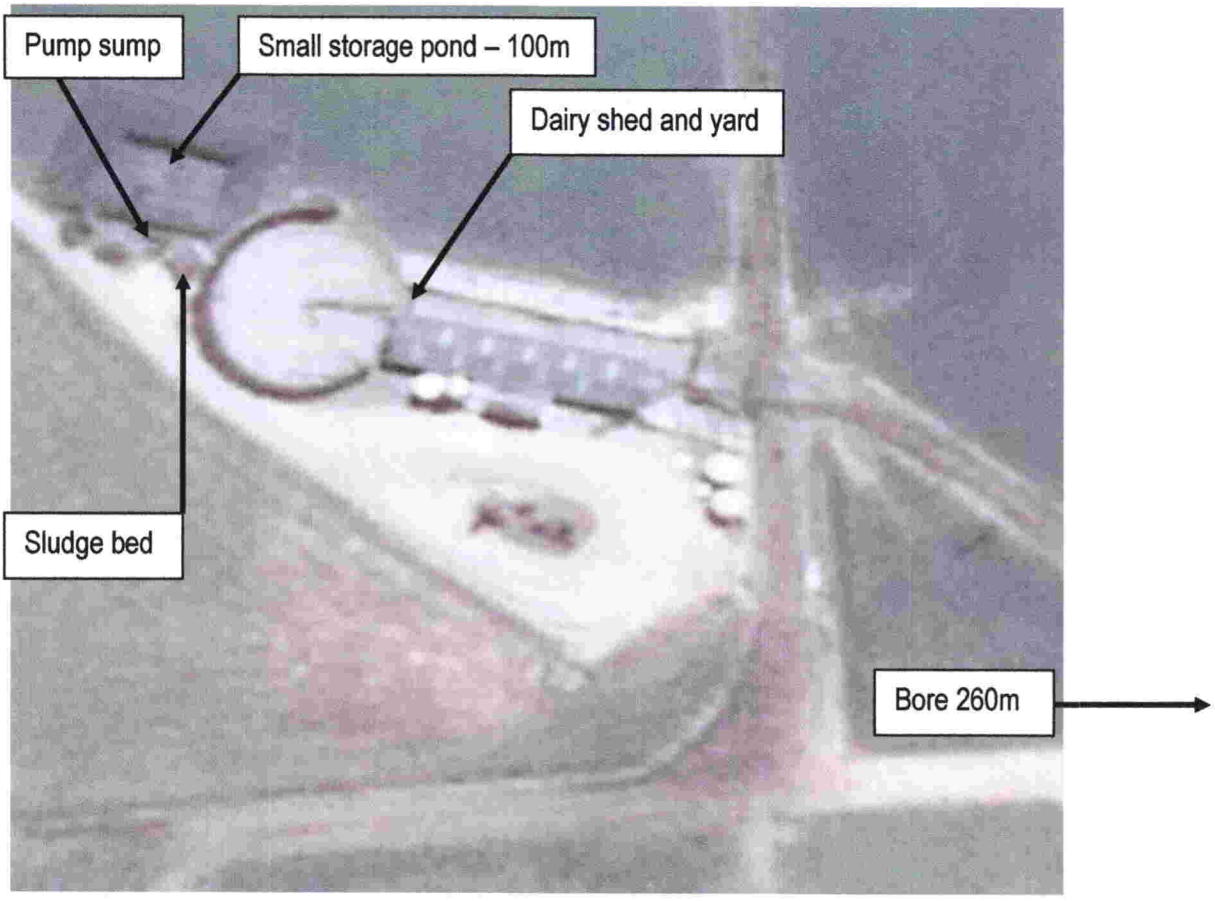
1. Advise person responsible
2. Seek help
3. Advise authorities
4. Mitigate the effect

5. EMERGENCY CONTACTS

Mr Dean Anderson	027 406 6878	
Environment Southland	0800 768 845	

Appendix 2 Effluent System Overview

All effluent is collected in the Shed yards and any concrete area around the dairy shed. It all flows by gravity to the stone trap where solids can settle and be removed. The liquid overflows by a pipe to the saucer where the irrigation pump is located. Effluent is irrigated from here as soil moisture levels permit. If irrigation is not possible then the effluent is pumped to a 3,000m3 Tasman storage tank. Effluent from the storage tank is released through a valve in the base of the tank and flows into the stone trap and saucer to be irrigated. This is controlled manually. The valve outlet in the base of the tank tends to allow the solids to be removed easily and there is no build-up of solids in the tank.



This aerial photograph is at 25 December 2015.

Infrastructure photographs

Looking east at yards and shed

Looking west at shed and yards

Stone trap – right and sludge bunker with weeping wall

Pump sump and storage pond behind

Pump sump and storage pond

Looking west along line of new feed pad

Looking north along line of new feed pad

Looking north along line of calving pad

Appendix 3 Effluent Storage

Dairy Effluent Storage Calculator
Summary Report

Regional authority: Environment Southland Regional Council
Authorised agent:
Client: South Dairy Ltd
Program version: 1.47
Report date: Thursday, 2 February 2017
General description:

Climate

Rainfall site: Winton
Mean annual rainfall: 958 mm/year

Effluent Block

Area of low risk soil: 10.0 hectares
Minimum area of high risk soil: 10.0 hectares
Surplus area of high risk soil: 180.0 hectares

Wash Water

Yard wash:

- Milking season starts: 10 August
- Milking season ends: 31 May

Month	Number of Cows	Hours in Yard	Wash Volume (cubic metres)
January	750	5.0	37.5
February	750	5.0	37.5
March	750	5.0	37.5
April	750	5.0	37.5
May	750	5.0	37.5
June	0	0.0	0.0
July	0	0.0	0.0
August	750	5.0	37.5
September	750	5.0	37.5
October	750	5.0	37.5
November	750	5.0	37.5
December	750	5.0	37.5

Feedpad wash:

Month	Number of Cows	Hours on Pad	Wash Volume (cubic metres)
January	0	0.0	0.0
February	0	0.0	0.0
March	0	0.0	0.0
April	0	0.0	0.0
May	400	8.0	0.0
June	0	0.0	0.0
July	0	0.0	0.0
August	600	12.0	0.0
September	400	12.0	0.0
October	0	0.0	0.0
November	0	0.0	0.0
December	0	0.0	0.0

Irrigation

Winter-spring depth:	7 mm
Spring-autumn depth:	15 mm
Winter-spring volume:	70 cubic metres
Spring-autumn volume:	130 cubic metres
Irrigate all year?	No
Don't irrigate start:	02 August
Don't irrigate end:	10 September

Catchments

Yard Area:	1600 square metres
Diverted?	Yes
- diversion start:	31 May
- diversion end:	01 August
Shed Roof Area:	298 square metres
Diverted?	Yes
Feedpad Area:	2730 square metres
Covered?	No
Diverted?	No
Animal Shelter Area:	0 square metres
Covered?	Yes
Diverted?	No
Other Areas:	2000 square metres

Storage

Pond/s present?	Yes
No. of ponds:	1 pond/s
Includes irregular ponds?	No
Pond 1	
- total volume:	6384 cubic metres
- pumpable volume:	5083 cubic metres
- surface area:	2704 square metres
- width:	52.0 metres
- length:	52.0 metres
- batter:	2.0:1
- total height:	3.0 metres
- pumped?	Yes
Tank/s present?	No
Emergency storage period:	3 days

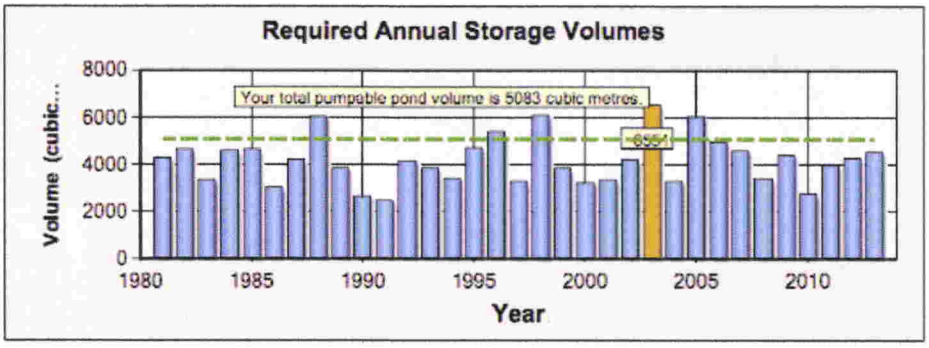
Solids Separation

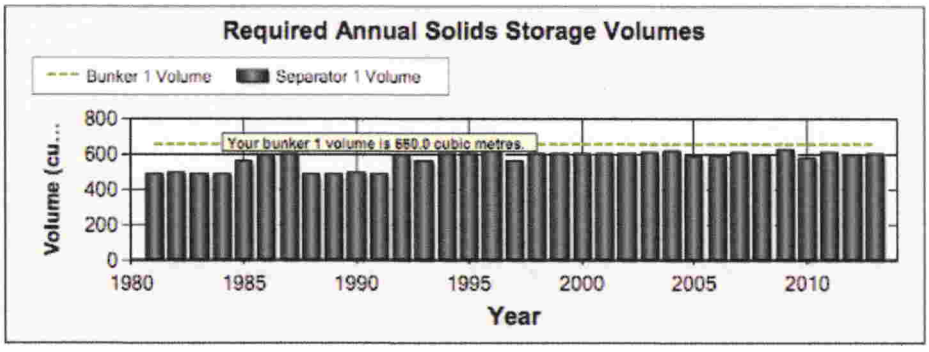
Solids separator/s present?	Yes
No. of separators:	1 separator/s
Separator 1	
- dry matter:	20 %
- source/s:	Yard
- separation starts:	01 August
- separation ends:	31 May
- bunker length:	40.0 metres
- bunker width:	11.0 metres
- bunker height:	1.5 metres

- minimum SWD:	7 mm
- minimum 4 day SWD excess:	25 mm
- don't empty start:	31 May
- don't empty end:	01 October
- minimum volume before emptying:	75 %

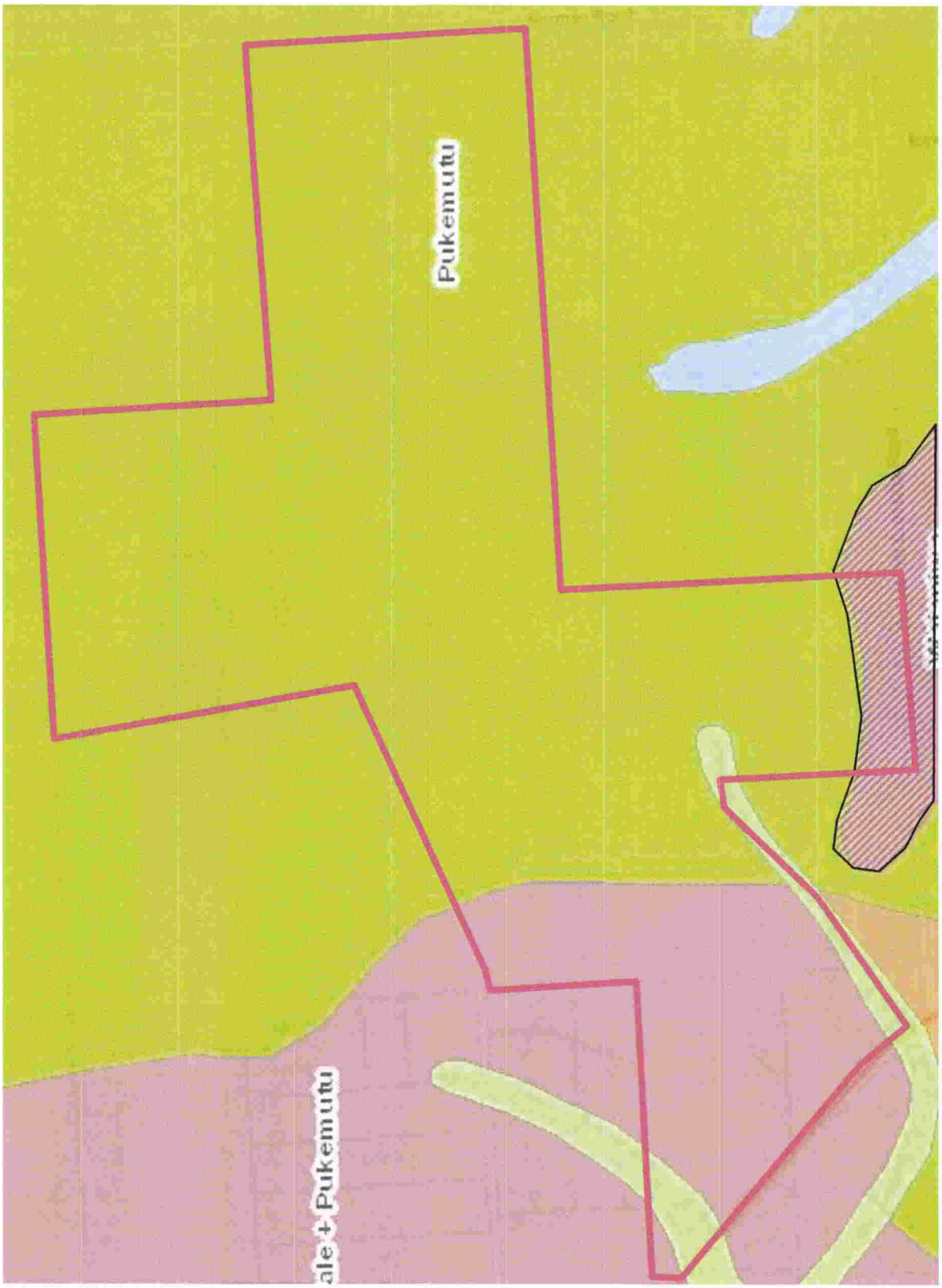
Outputs

Maximum required storage pond volume:	6551 cubic metres
90 % probability storage pond volume:	5522 cubic metres
Maximum required solids bunker volume:	654.6 cubic metres
During the period from:	01 July 1980
To:	30 June 2013



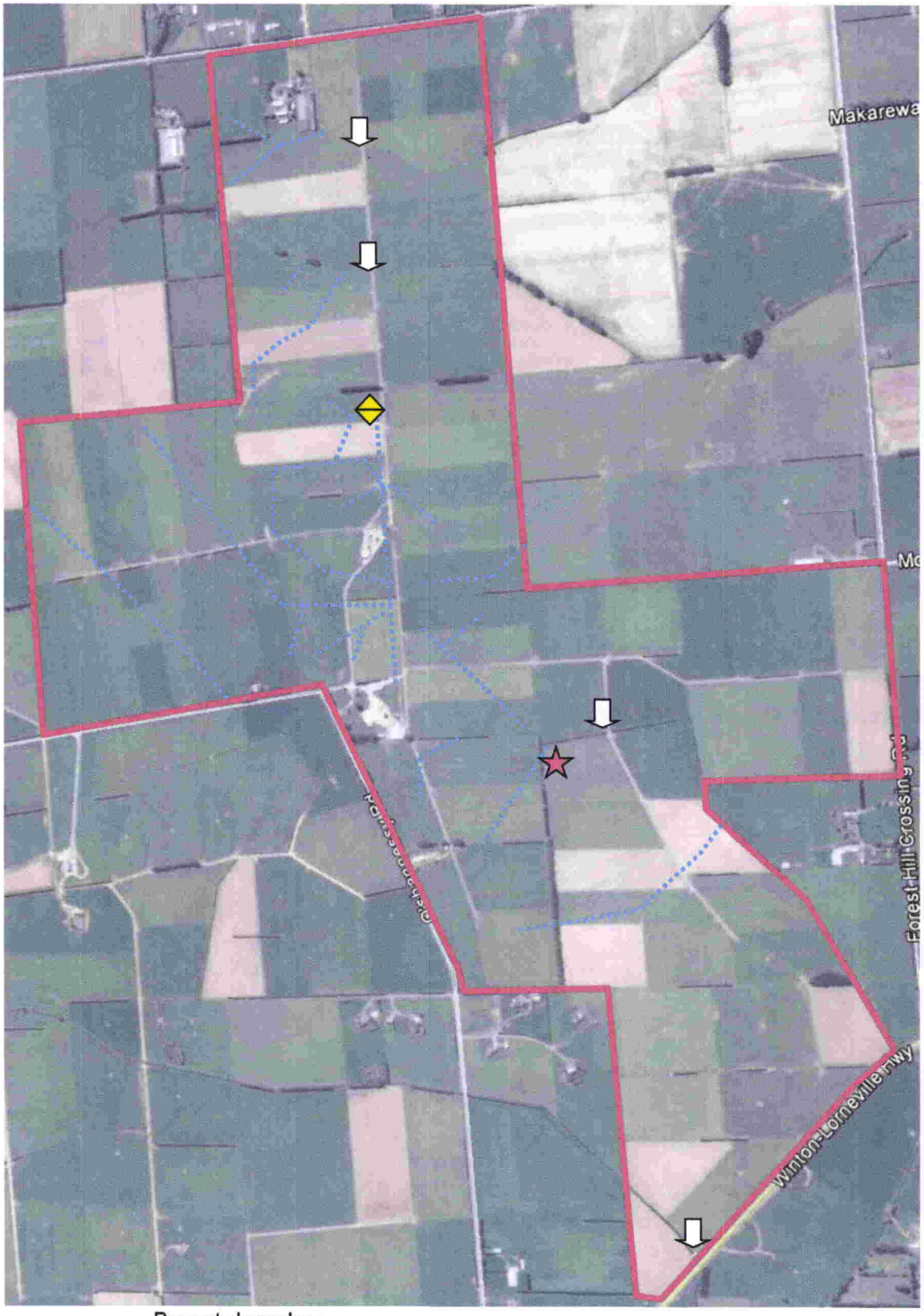


Appendix 4 Soil Map

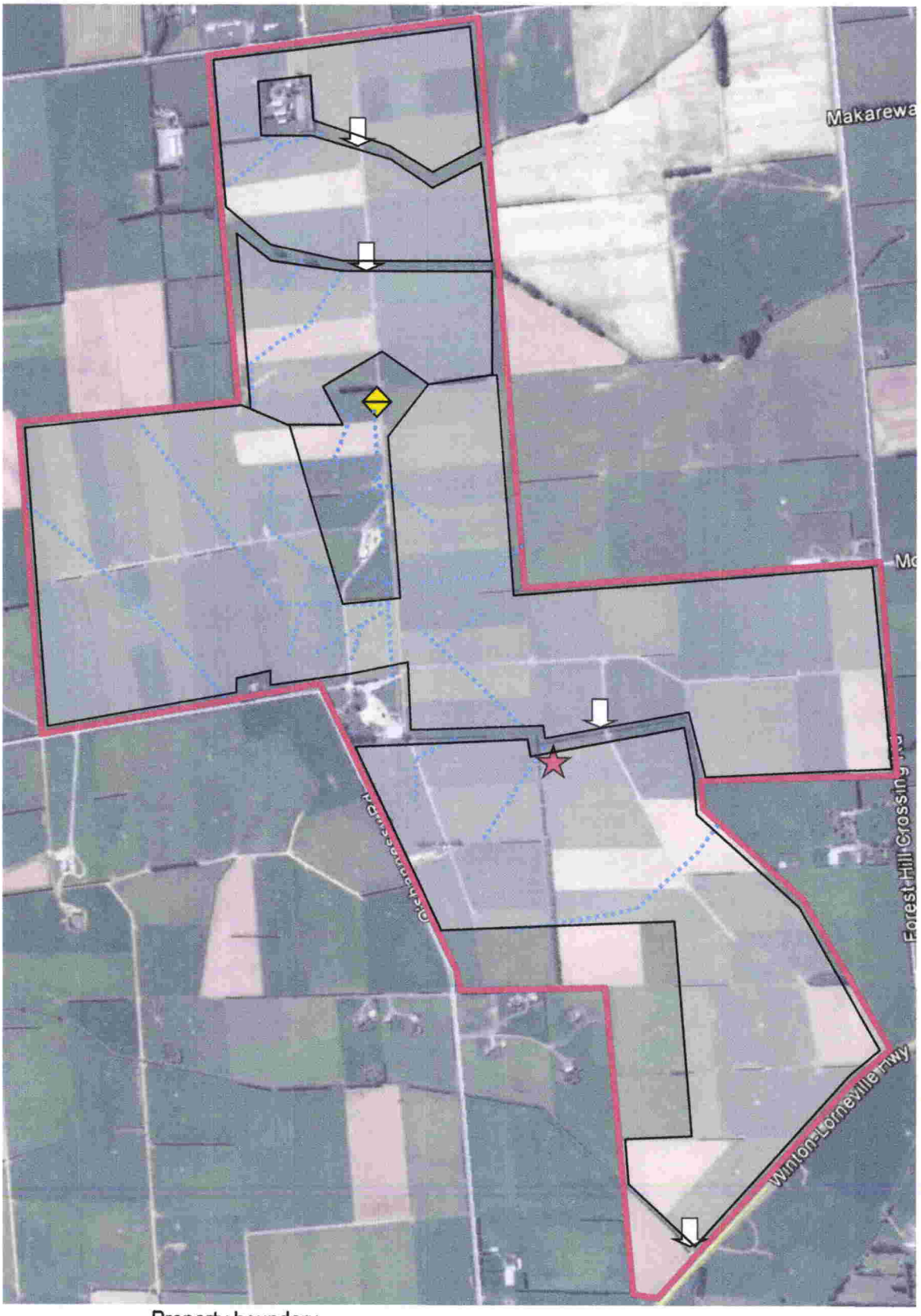


Green	Pukemutu
Brown	Edendale
Brown hatched	Waianiwa
Light Green	Northope

Appendix 5 Subsurface Drain Map



Appendix 6 Effluent Area Map



Property boundary

Discharge area

Appendix 7 Design and Construction Checklist

South Dairy Ltd

373 O'Shannessy Road

Lochiel

Pond Volume

Pond volume	5,060m3
Number of days storage	Volume calculated by Massey DESC
Some solids will be removed by stone trap and pump sump	
Freeboard	500mm
Minimum batter slope	2:1
Liquid depth	2.5m

Existing Farm Effluent System

Existing infrastructure – All effluent from the shed and yard flows by gravity to a stone trap to the west of the shed and then by gravity to the in-ground concrete tank pump sump. The solids from the stone trap are placed in a purpose built concrete bunker with a weeping wall where any liquid flows to the pump sump and then pumped to the new storage pond. At present there is a small storage pond adjacent to the pump sump which can hold about 100m3 of effluent. This will be used until the new pond is built. Other effluent collection areas include two feed pads and a calving pad but all these areas will be used as stand-off/feed/calving and wintering areas to keep stock of pasture to reduce damage and phosphorus loss. The feed pads will be scraped and solids stored at the south and east end of the pads and the liquid will drop into a pump sump and be pumped to the storage pond. The calving pad will be on a drained clay base where any liquid will flow to a pump sump and then pumped to the storage pond. The calving pad will not be able to be diverted but all other concrete areas will be diverted whenever possible. When the effluent flows to the pump sump and if soil moisture levels and weather forecast is suitable, effluent will be pumped to the discharge area and irrigated by a Briggs 15 irrigator or a new Cobra rain gun. A slurry tanker or umbilical system will be used to take effluent to the areas that do not currently have underground effluent lines. If ground conditions are not suitable then effluent is stored in a 5,060m3 storage pond which will be constructed. Until it is constructed the existing pump sump and small storage pond will be used. Effluent from the storage pond will be pumped back to the pump sump to irrigate out to the discharge area or picked up at the pond by slurry tanker or umbilical system.

Climate data	958mm/year Winton
Land application area	200 hectares – Travelling irrigator, rain gun, slurry tanker or umbilical system
Soil types	Pukemutu, Waianawa and Northope - high risk soils. Edendale – low risk soil
Catchment Areas	Yards – 1,600m2 diverted, shed roof – 298m2 diverted, feed pad – 2800m2 diverted, Calving pad and other areas – 2800m2
Water volumes	50 litres/cow/day for wash down
Irrigation	5 – 10mm with 75 - 120m3/irrigation day
Pond details	5,060m3 construct with on site materials and 1.5mm HDPE liner

The FDE system will operate as at present with the new pond providing additional storage.
Access for construction and maintenance equipment provided
Freeboard 500mm

Geotechnical Assessment

The material in which the pond will be built is yellow clayey silt. The site is on a flat higher part of the farm. The clayey silt at the site is dry. The pond will be excavated through the topsoil and into the clayey silt with no additional material required to build the walls. The base of the pond will be above the water table. The silt is stable with good construction qualities when built in thin layers at optimum moisture content. The construction material is competent silt.

Hydrological Assessment
The pond is to be built on a high part of a flat farm and into deep yellow clayey silt. A test pit was dug to 3.0m at the pond site. There was no indication of water in the base of this site. The pond will be constructed of original material and built above the water table. There will be no hydrostatic pressure on the pond when empty. The pond will have a subsoil drain with drainage gravel in the pond base which will run to an inspection chamber. The pond will have a geotextile fabric liner and 1.5mm synthetic liner.

Design

Bank protection	Synthetic liner
Batter slope	2:1
Protection of storage pond at entry from pipe	Synthetic liner – double thickness
Protection of storage pond for stirrer base	Synthetic liner – double thickness
Fence requirement included in plans and specification	

Construction
Dean Shearing Ltd
Equipment used
15 tonne excavator
10 tonne roller

Construction sequence	Strip topsoil
	Construct keyways and roll in layers
	Build walls in layers with rolling
	Shape walls and top of wall to outside
	Install subsoil drainage and inspection chamber
	Install synthetic liner
	Place topsoil around outside wall, landscape and sow
	Install pipework and fence

On site testing
On site to set out pond. After topsoil is stripped, check site for any previous disturbance of the site materials and probe and take Scala penetrometer reading of existing clay layer if there is not stone present. Check keyway construction and carry out proof rolling during keyway filling to determine optimum number of passes. Take Scala of completed compaction if possible. Take NDMs of layers if required. Visit site every 2 days if one excavator operating, more if another operating. On each visit record: date, time, weather, machinery on site, what was inspected (what they were doing or had completed and location). Any instruction given, if photographs were taken (always), anything to follow up on next visit and any variation required. The last inspection will be on completion of the earthworks component prior to the liner being installed.

The plans and specification including the construction methods and liner material will achieve a leakage rate low enough to avoid environmental contamination. The floor level will be above the height of the water table. Protection and maintenance of the pond and liner will be provided for by the owner. All consent conditions for the pond will be met.

The pond liner will have a 20 year warranty on the liner material and 5 year warranty on workmanship.

Monitoring
Check pond level as required.
Check the liner for any signs of wear or tear.
Check the inspection chamber monthly

Test Pit

One test pit was dug at the site. There was 400mm of topsoil and then into consistent silt to a depth of at least 2.7m with gravel below. I have constructed 4 ponds within 5 kilometres of this site.

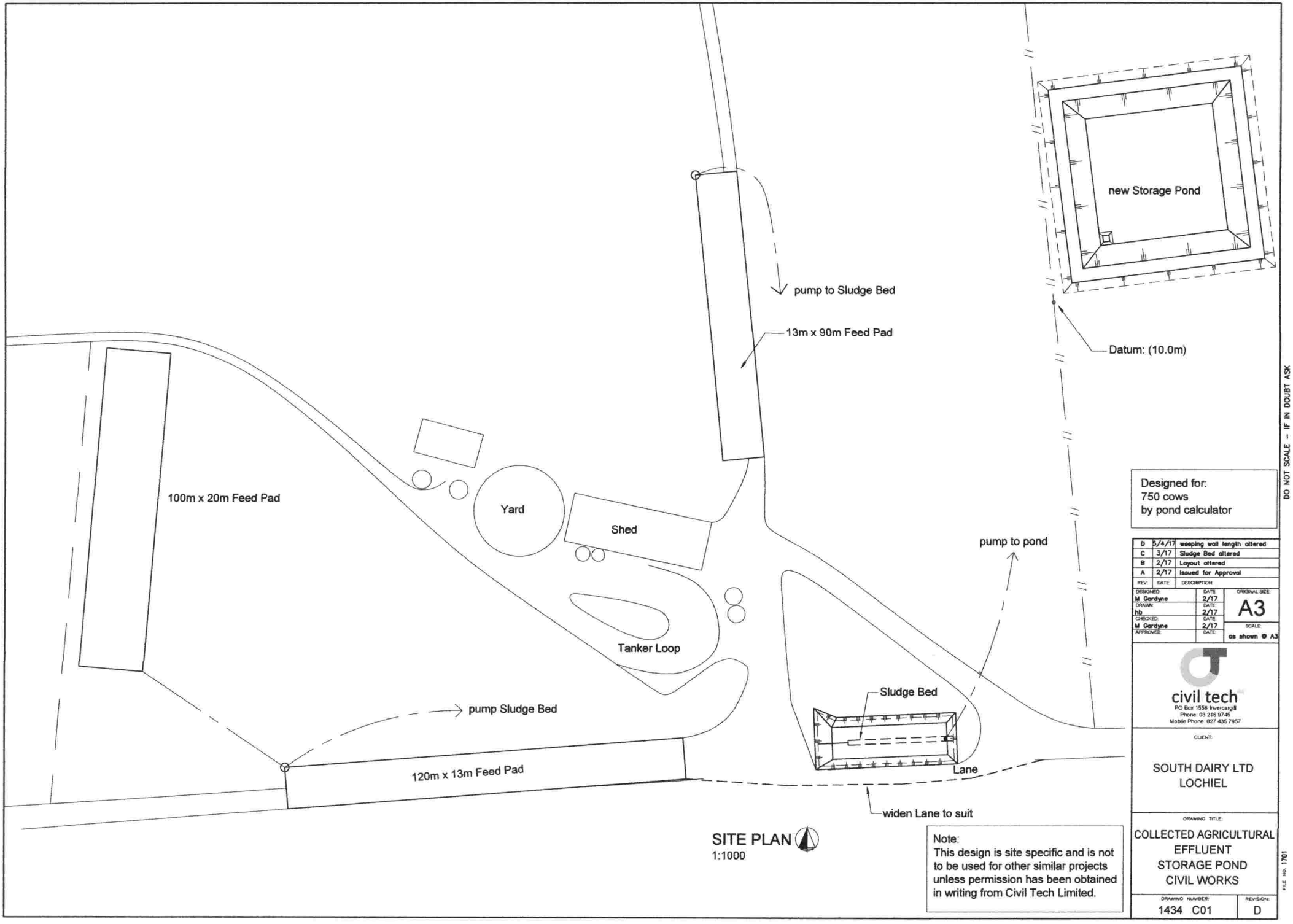
Buffer distances

The pump sump is 35m to the milk pick up point and 30m to the cups but is less than 22.5m3 and is not required to be 45m from the cups. The new pond will be 120m from the cups. Minimum is 45m. The pond will is 520m from an open waterway. Minimum is 50m. The existing small storage pond will be decommissioned once the new pond is installed.

Client:	**South Dairy Ltd**
Location:	**Lochiel**
Tested by:	**Murray Gardyne**
Date:	**7-Nov-16**

Location	**Depth**	**Material description**
TP 1	0 - 400	Topsoil
	400 - 2700	Yellow clay - gleyed
	2700 - 3000	Clay bound gravel - rust stains

Good material to build pond walls with. Rolls well. Will not get down to gravel and will be above watertable. Note the water in the hole is from rainfall as the pit was dug several days before inspection.



SITE PLAN
1:1000

Designed for:
750 cows
by pond calculator

REV.	DATE	DESCRIPTION
D	5/4/17	weeping wall length altered
C	3/17	Sludge Bed altered
B	2/17	Layout altered
A	2/17	Issued for Approval

DESIGNED: M Gardyne	DATE: 2/17	ORIGINAL SIZE: A3
DRAWN: hb	DATE: 2/17	
CHECKED: M Gardyne	DATE: 2/17	SCALE: as shown @ A3
APPROVED:	DATE:	

civil tech
PO Box 1556 Invercargill
Phone: 03 218 9745
Mobile Phone: 027 435 7957

CLIENT:
SOUTH DAIRY LTD
LOCHIEL

DRAWING TITLE:
COLLECTED AGRICULTURAL EFFLUENT STORAGE POND CIVIL WORKS

DRAWING NUMBER:	REVISION:
1434 C01	D

Note:
This design is site specific and is not to be used for other similar projects unless permission has been obtained in writing from Civil Tech Limited.

DO NOT SCALE – IF IN DOUBT ASK

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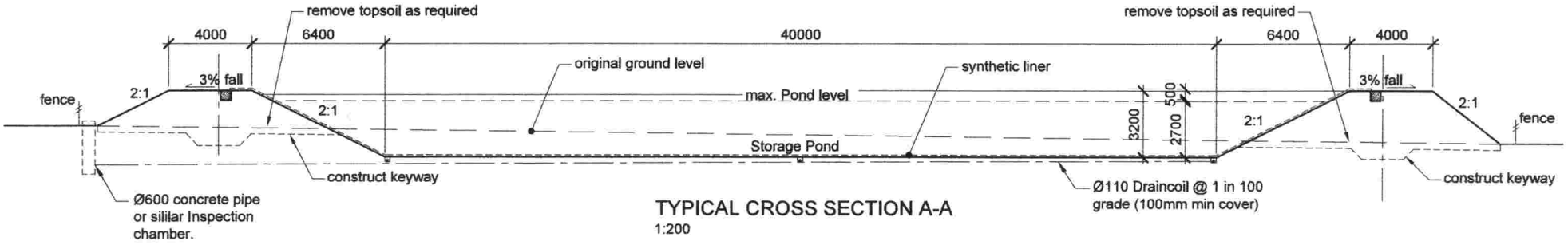
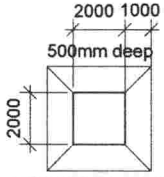
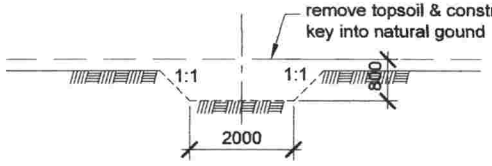


TYPICAL CROSS SECTION A-A
1:200

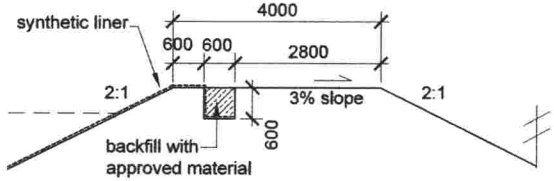


TYPICAL PUMP SUMP DETAIL
1:200

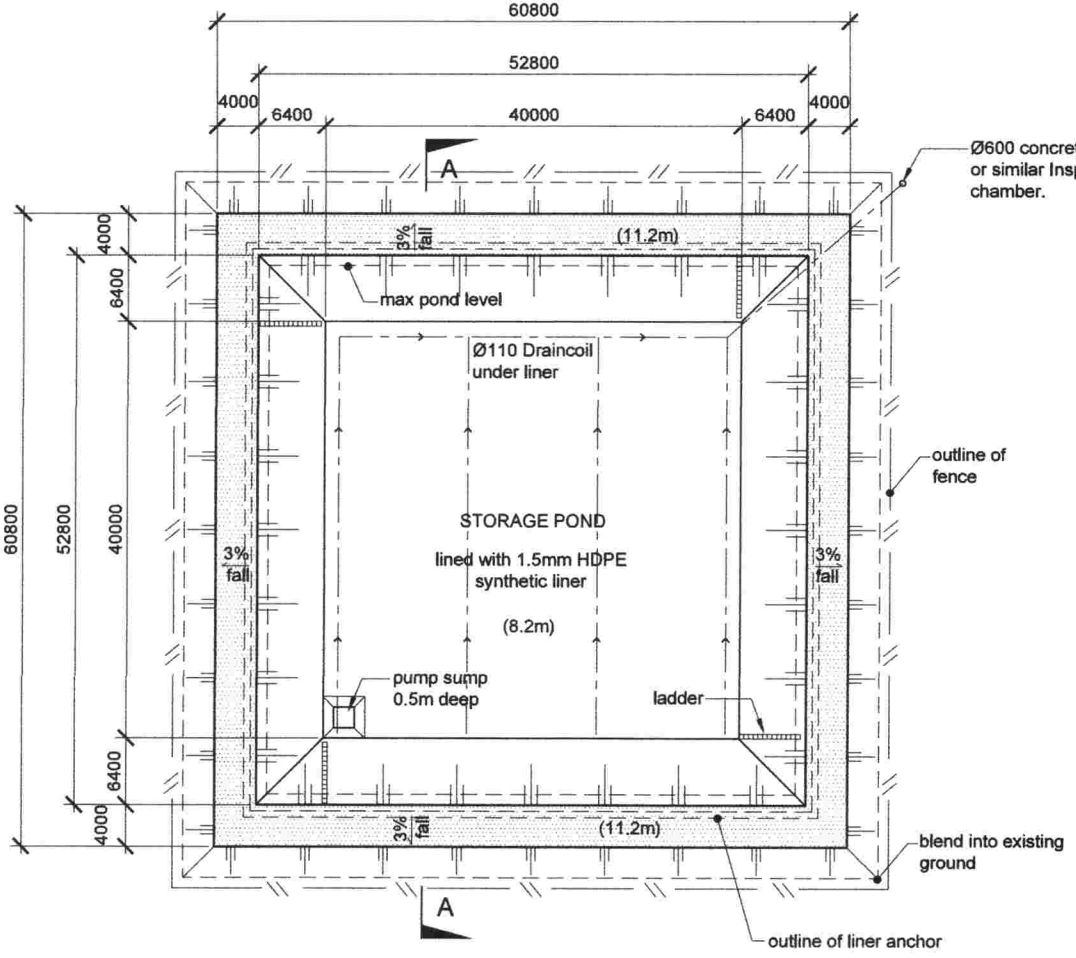
Note:
This design is site specific and is not to be used for other similar projects unless permission has been obtained in writing from Civil Tech Limited.



KEY DETAIL
1:100

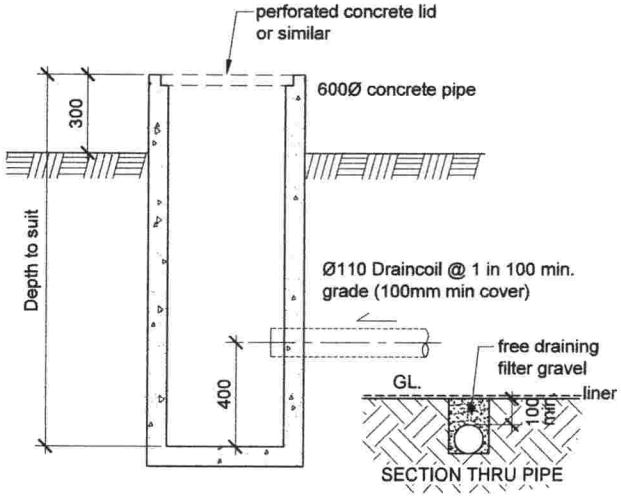


TYPICAL LINER ANCHOR DETAIL
1:100



STORAGE POND PLAN
1:500

Allow for safety fence around ponds



INSPECTION CHAMBER DETAIL
1:20

Designed for:
750 cows
by pond calculator

REV.	DATE:	DESCRIPTION:
D	5/4/17	weeping wall length altered
C	3/17	Sludge Bed altered
B	2/17	layout altered
A	2/17	Issued for Approval

DESIGNED: M Gardyne	DATE: 2/17	ORIGINAL SIZE: A3
DRAWN: hb	DATE: 2/17	
CHECKED: M Gardyne	DATE: 2/17	SCALE: as shown @ A3
APPROVED:	DATE:	

civil tech
PO Box 1558 Invercargill
Phone: 03 216 9745
Mobile Phone: 027 435 7957

CLIENT:
SOUTH DAIRY LTD
LOCHIEL

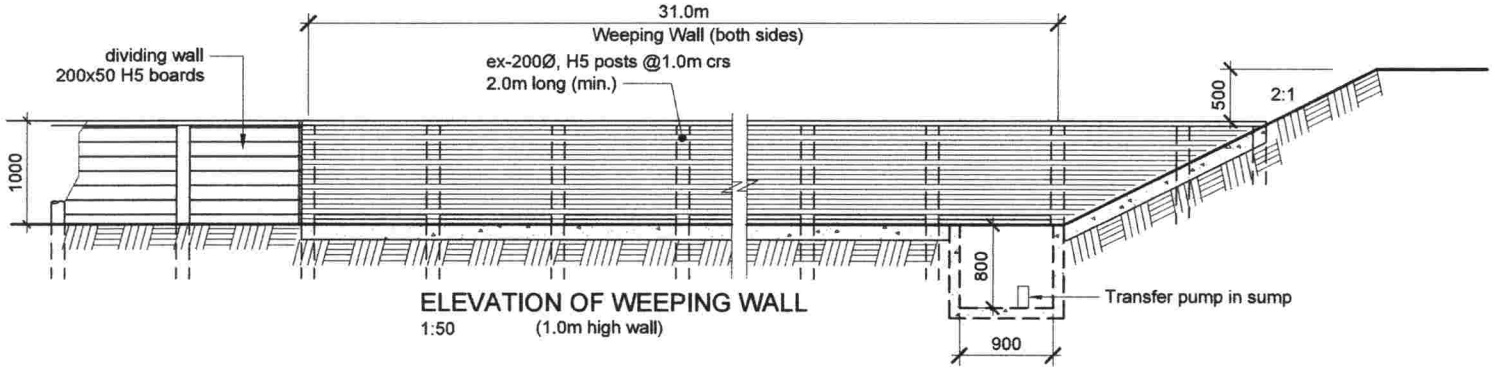
DRAWING TITLE:
COLLECTED AGRICULTURAL EFFLUENT STORAGE POND CIVIL WORKS

DRAWING NUMBER:	REVISION:
1434 C02	D

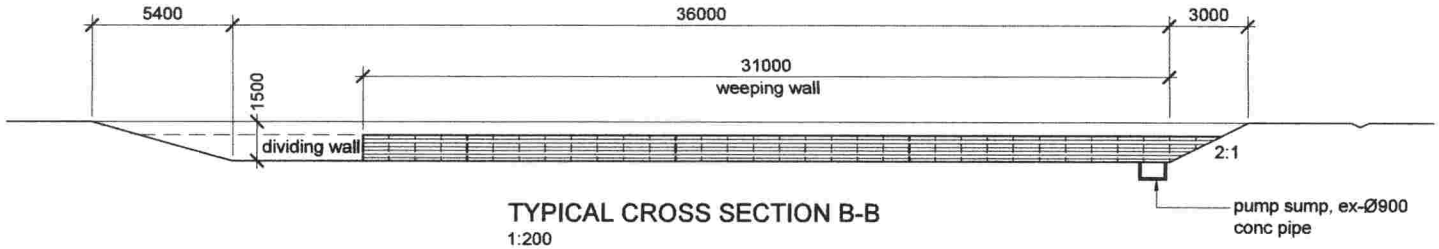
DO NOT SCALE – IF IN DOUBT ASK

FILE NO: 1701

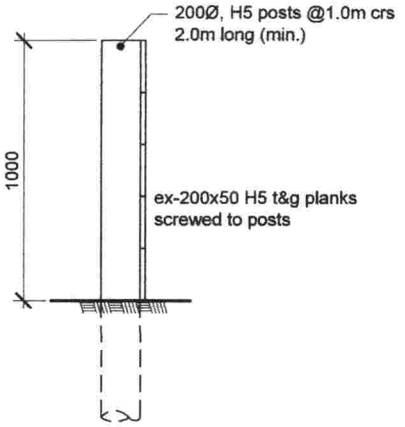
Note:
This design is site specific and is not to be used for other similar projects unless permission has been obtained in writing from Civil Tech Limited.



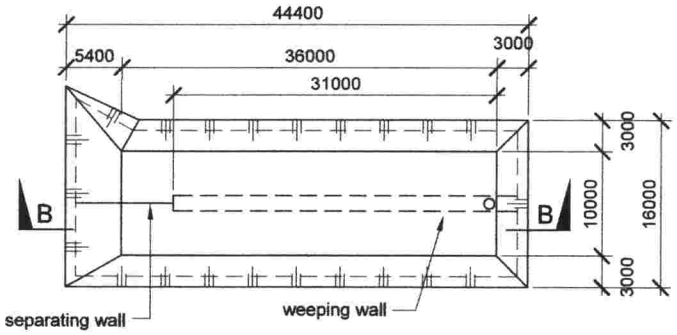
ELEVATION OF WEEPING WALL
1:50 (1.0m high wall)



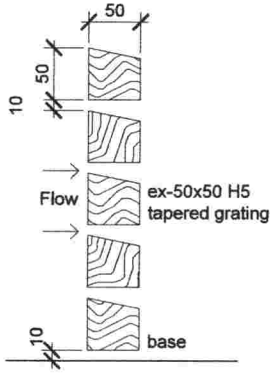
TYPICAL CROSS SECTION B-B
1:200



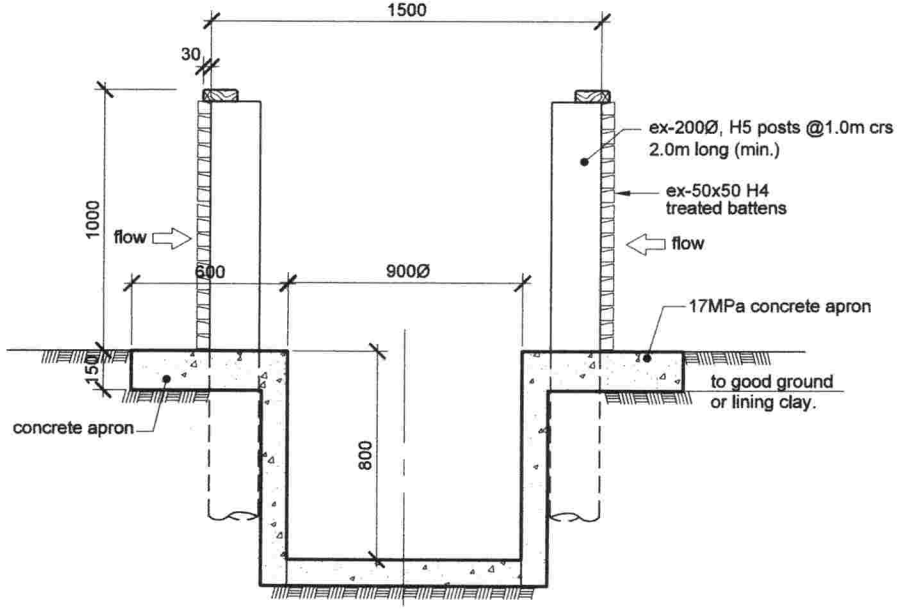
SEPARATING WALL DETAIL
1:20 (1000m high)



SLUDGE POND PLAN
1:500



GRATING DETAIL
1:5 (Elevation)



TYPICAL TWIN WEEPING WALL DETAIL
1:20 (1000m high)

Designed for:
750 cows
by pond calculator

REV.	DATE:	DESCRIPTION:
D	5/4/17	weeping wall length altered
C	3/17	Sludge Bed altered
B	2/17	Layout altered
A	2/17	issued for Approval

DESIGNED: M Gardyne	DATE: 2/17	ORIGINAL SIZE: A3
DRAWN: hb	DATE: 2/17	
CHECKED: M Gardyne	DATE: 2/17	SCALE: as shown @ A3
APPROVED:	DATE:	

civil tech
PO Box 1558 Invercargill
Phone: 03 218 9746
Mobile Phone: 027 435 7957

CLIENT:
SOUTH DAIRY LTD
LOCHIEL

DRAWING TITLE:
COLLECTED AGRICULTURAL EFFLUENT STORAGE POND CIVIL WORKS

DRAWING NUMBER:	REVISION:
1434 C03	D

DO NOT SCALE – IF IN DOUBT ASK

FILE NO: 1701

Specification for Earthworks Construction

for Collected Agricultural Effluent Storage Pond

Client: South Dairy Ltd

Location: Lochiel

Project No.: 1434

Specification for Earthworks Construction

1. Scope

This specification covers the construction of earthworks including: the clearing and removal of all obstacles within the limits of the earthworks; Stripping of topsoil; excavation of all cuts, including excavation below the final subgrade surface; the excavation of borrow areas, benches, keyways and surface drainage facilities; the carting of excavated material to fill or waste; and construction of fills and subgrade; shaping, compacting, trimming and topsoiling. Any changes to the construction of the pond must be discussed with the certifier and any changes to the original plan will be confirmed in writing.

2. Initial site meeting

At the first meeting on site the location of the pond will be confirmed and any hazards identified that would affect the construction. Contractors shall confirm that the equipment that will be used on the site is appropriate and has sufficient roll over protection to work on slopes. All underground services about the site are to be confirmed. ie power, telecom, water and drainage etc.

3. Construction progress and recording

The contractor shall retain sufficient records to show what work was constructed each day, and suitable photographs held to record this.

4. Pond set out

The pond shall be set out so that the final dimensions of the pond and the levels of the walls correspond to the plans to ensure that the full design capacity of the pond is achieved and that the pond operates as it is designed.

5. Clearing

The area contained by the limits of the earthworks and any additional area shown on the drawings shall be cleared of all obstructions. Clearing shall include the complete removal fences, stumps, trees, scrub and disposal by dumping and burying as required.

6. Removal of topsoil

Topsoil shall be removed to outside of the top of the pond wall. Care shall be taken to avoid contamination of the structural fill material below the topsoil layer.

7. Surface drainage

Adequate provision shall be made for the control of surface water within the construction area to safeguard the integrity of the works. The earthworks shall be carried out in such a manner that their surfaces have at all times a sufficient fall to shed water and prevent flooding. No silt contaminated water shall be pumped into any open drain but spread to pasture to filter silt prior to entering an open drain.

8. Excavation

Excavation shall be carried out in such a manner to avoid mixing of the materials if they are to be used for lining the pond rather than for the construction of the walls. Excavation shall be carried out so as to limit overbreak as far as is practical.

9. Unforeseen irregularities

If during excavation any of the following are exposed, the method of resolving the irregularities are to be discussed with the certifier and the best option to remove or modify the excavation confirmed. These may include mole or tile drains, under runners, sand or gravel inclusions, bog wood, trees or rubbish pits.

10. Keyway construction

On all walls of the pond that are to be constructed a keyway shall be constructed to a minimum depth of 600mm deep and 2m wide. The backfill to the keyways shall be compacted as detailed in section 14.

11. Filling

The earthworks shall be managed in such a manner that the best material for clay lining is reserved for placement on the inside of the main storage pond. The location of this material shall be discussed with the certifier. The material used in fill shall be spread and compacted in layers of uniform quality and thickness. The thickness of each layer shall be limited to ensure that the specified compaction is achieved for the full depth of each layer. The movement of construction traffic shall be even distributed over the full width of the filling area, so as to avoid damage or overstress the compaction. If material which has already been placed in fill is considered by the certifier to be too wet then, the Contractor shall either dry or mix the material so that it is suitable for fill or excavate the material to waste and replace it with suitable material.

12. Compaction Methods

The Contractor shall submit to the certifier details of the proposed compaction methods and details of the compaction equipment before filing commences.

13. Layer Thickness

The maximum thickness of each layer of fill before compaction shall be 200mm

14. Compaction

Compaction of each layer shall continue until the whole layer has obtained a dense condition. The degree of compaction of each layer shall be such that when trimmed to a smooth surface, the resultant impression in the surface under a smooth wheel roller having a minimum loading of 6260kg per metre width of fill shall not be greater than 5 mm. The maximum dry density achieved shall be 98%. This will require a minimum number of four passes over the total fill area and all layers. Construction will be accepted on the basis of an area at a time. Each area offered for acceptance shall consist of material which is basically the one soil type which appears to be constant moisture content and which has received a uniform number of roller

passes. The Certifier or his representative shall determine the locations of tests within each area. Test results shall be analysed in groups of five. When drying is necessary it shall be carried out to allow the full depth of the layer to dry uniformly. Drying and compaction shall be carried out under favourable weather conditions. Compaction shall not continue if the material shows signs of heaving or weaving excessively. In this situation the material shall be either left to dry naturally or where job progress would be affected by delay the material shall be dried to a moisture content at which heaving and weaving does not occur.

15. Disturbance and working of cut surfaces

Where the pond is cut into the existing clay subgrade that is of suitable quality for pond lining, it shall be scarified to a depth of 300mm and re compacted to provide a dense tight surface to the same density as any other compacted surface.

16. Synthetic Lining

The synthetic lining for the storage pond shall be installed by a qualified installer and provide the quality assurance documentation to provide a 20 year warranty for the liner.

17. Finished surface slopes

The pond walls shall be shaped to a maximum slope of two horizontal to one vertical or flatter. All outside top of walls shall be sloped to shed water to the outside of the storage pond or sludge beds so that excess stormwater does not enter the ponds

18. Trimming and rolling

The entire surface of the inside of the pond shall be made firm, uniform and smooth by blading, grading and rolling. Rolling associated with the surface finishing shall be the same as that which would produce the compaction for that material type.

19. Surface water channels

All areas where the existing ground surface slopes toward the ponds a shallow surface water channel shall be constructed as shown on the plans. This will lead water away from the pond to a suitable outfall.

20. Topsoiling

Topsoil shall be re spread to provide smooth and natural transitions between the ponds and the surrounding pasture areas. The topsoil shall be worked and trimmed to a tilth suitable for typical farm machinery to finish suitable for grass. The outside batters shall be topsoiled and sloped so that they can be cultivated, sown with grass and mown if required.

21. Fencing

Fencing, although required on all ponds, shall not be the responsibility of the contractor or certifier.

Building Code Clause(s) NA

PRODUCER STATEMENT – PS1 – DESIGN

(Guidance on use of Producer Statements (formerly page 2) is available at www.ipenz.nz)

ISSUED BY: Civil Tech Ltd
(Design Firm)

TO: South Dairy Ltd
(Owner/Developer)

TO BE SUPPLIED TO: Environment Southland
(Building Consent Authority)

IN RESPECT OF: Agricultural Effluent Storage Pond
(Description of Building Work)

AT: 373 O'Shannessy Road, Lochiel
(Address)

Town/City: Winton (Address) **LOT** Sec 1 Blk 1 Winton **DP** ..... **SO** .....

We have been engaged by the owner/developer referred to above to provide:

Design of a agricultural effluent storage pond.

(Extent of Engagement)

services in respect of the requirements of Clause(s) NA of the Building Code for:

☐ All or ☐ Part only (as specified in the attachment to this statement), of the proposed building work.

The design carried out by us has been prepared in accordance with:

☐ Compliance Documents issued by the Ministry of Business, Innovation & Employment NA (verification method/acceptable solution) or

☐ Alternative solution as per the attached schedule NA

The proposed building work covered by this producer statement is described on the drawings titled:

Dairy Effluent Storage Pond - Civil Works and numbered 1434 CO1 - CO3, Rev D;
together with the specification, and other documents set out in the schedule attached to this statement.

On behalf of the Design Firm, and subject to:
(i) Site verification of the following design assumptions .....
(ii) All proprietary products meeting their performance specification requirements;

I believe on reasonable grounds that a) the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the attached schedule, will comply with the relevant provisions of the Building Code and that b), the persons who have undertaken the design have the necessary competency to do so. I also recommend the following level of construction monitoring/observation:

☐ CM1 ☐ CM2 ☐ CM3 ☐ CM4 ☐ CM5 (Engineering Categories) or ☐ as per agreement with owner/developer (Architectural)

I, Murray Gardyne (Name of Design Professional) am: ☐ CPEng ..... # ☐ Reg Arch ..... #

I am a Member of: ■ IPENZ ☐ NZIA and hold the following qualifications: NZCE (civil), REA, AIPENZ
The Design Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than $200,000*.
The Design Firm is a member of ACENZ: ☐

SIGNED BY Murray Gardyne (Name of Design Professional) (Signature) .....

ON BEHALF OF Civil Tech Ltd (Design Firm) Date 15/03/2017

Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of $200,000.*

This form is to accompany **Form 2 of the Building (Forms) Regulations 2004** for the application of a Building Consent.

PRODUCER STATEMENT – PS2 – DESIGN REVIEW

ISSUED BY:	Hadley Consultants Limited, P.O. Box 1356, Queenstown. *(Design Review Firm)*
TO:	South Dairy Limited *(Owner/Developer)*
TO BE SUPPLIED TO:	Environment Southland *(Consent Authority)*
IN RESPECT OF:	The design of a Farm Dairy Effluent Storage Pond with a proprietary HDPE liner. *(Description of Work)*
AT:	373 O'Shannessy Road, Lochiel, Southland.
LEGAL DESCRIPTION:	Sec 51 Blk 1 Winton Hundred

We Hadley Consultants Limited have been engaged by Civil Tech Limited to review the design documents for this project in respect of the requirements of IPENZ Practice Note 21.

This review is for part of the design wok prepared by Civil Tech Limited as described in drawings titled Collected Agricultural Effluent Storage Pond Civil Works and numbered 1434 – C01 to C03 - Rev B together with the specification, and design and construction checklist according to which the Dairy Effluent Storage Pond is proposed to be constructed.

This review is in respect of the geotechnical suitability of the proposed location and risks, the stability of proposed embankments, the adequacy of liner protection and secondary drainage and the adequacy of liner anchorage, all for the proposed Dairy Effluent Storage Pond.

The Review confirms that these aspects of the design are in accordance with: IPENZ Practice Note 21.

On behalf of the firm undertaking this review, on the basis of the review undertaken, and subject to:

(i) Site verification of design assumptions with particular regard to the subgrade conditions and suitability of material for use as engineered fill,
(ii) The engineering work covered by this statement being inspected at appropriate times during construction by a representative of Hadley Consultants Ltd,
(iii) All construction work being carried out in accordance with the relevant sections of IPENZ Practice Note 21,
(iv) All proprietary products meeting their performance specification requirements;

I believe on reasonable grounds that a) the Farm Dairy Effluent Storage Pond if constructed in accordance with the drawings, specifications, and other documents provided or listed in the attached schedule, will comply with the relevant provisions of IPENZ Practice Note 21 and that b) the persons who have undertaken the review have the necessary competency to do so.

The Design Review Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than $200,000*. The Design Review Firm is a member of ACENZ.

.....

DATE: 7 April 2017

J.W.P Hadley on behalf of Hadley Consultants Limited

QUALIFICATIONS: B.E. (Hons), MIPENZ, IntPE, CPEng. REFERENCE No. 189829

Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Review Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of $200,000.

FACTSHEET

WATER AND LAND 2020 & BEYOND

Physiographic zone: Gleyed

Southland's physiographic zones allow us to better understand why we have variations in water quality in different areas. We've divided Southland into nine different zones according to factors such as soil type, geology and topography. Through them we can target solutions to higher risk areas as opposed to a region-wide, generalised approach.

Understanding your zone

Each zone is different in the way contaminants build up and move through the soil, areas of groundwater, and into our streams and rivers. Physiographic zones allow us to target advice and management strategies to keep farm nutrients on the farm and out of waterways.

The Physiographics of Southland project was developed as part of *Water and Land 2020 & Beyond* so we can better understand:

- where our water comes from
- how water moves through the landscape
- why we have differences in water quality across the region

What does 'Gleyed' mean?

The Gleyed zone is found in low-lying areas.

Soils are poorly drained, prone to waterlogging, and have distinctive grey or rust-coloured spots or mottles.

Soils and aquifers can remove some to all nitrogen via denitrification.

Key features of the Gleyed zone

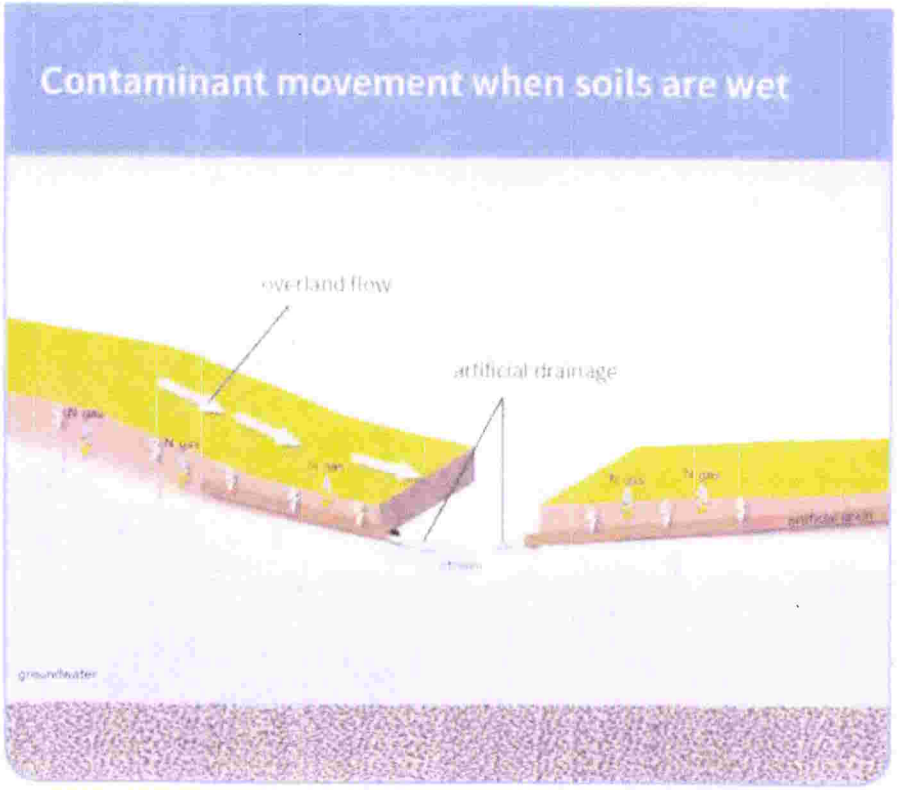
- Low lying flat to undulating land on alluvial terraces, located between the major river systems on northern and southern plains
- Generally found in historic wetland areas, and have a high water table during winter that's up to one metre below ground
- Soils are generally fine textured, prone to water logging, and have extensive artificial drainage (mole and tile drains).
- Some nitrogen is removed from water infiltrating through the soil zone via denitrification (lost as nitrogen gas).
- Loss of nutrients, sediments and microbes via artificial drains following heavy or prolonged rainfall are a key feature of this zone
- Water in this zone is not directly linked to any of the major rivers and therefore does not experience dilution from Alpine or pristine Bedrock/ Hill Country zones.

Water source and movement

- When soils are wet, excess water from rainfall in flatter areas will flow via an extensive drainage network to nearby streams.
- In undulating areas excess water may also flow across the land surface as overland flow (runoff) during heavy rainfall.
- Some water will slowly make its way down to underlying aquifers.
- Aquifers are shallow and interconnect with streams and drains.

Contaminant movement

Soils may accumulate and store nitrogen during summer and early autumn when soil moisture levels are low. However, some nitrogen will be removed from the soil and aquifers via denitrification (lost as nitrogen gas), resulting in relatively low groundwater nitrate concentrations. Accumulated nitrogen starts moving with water when soils become wet in late autumn and winter and may be lost via artificial drains or overland flow.



During periods of heavy rain, phosphorus, nitrogen, sediment and microbes flow with water overland (overland flow) and via artificial drain networks to neighbouring streams. Some nitrogen is lost to underlying groundwater however the denitrifying ability of soils results in low levels of nitrogen contamination in groundwater.

What does this mean for water quality?

√ Some denitrification may occur within the soil zone

X Artificial drainage rapidly move excess soil water and contaminants to rivers and streams particularly during heavy rainfall and wet periods.

Improving Southland's water quality

The following good management practices are applicable to all physiographic zones in Southland:

- Capture nutrients, sediment and microbes in wetlands and sediment traps
- Nutrient management
- Riparian management
- Effluent management

Good management in the Gleyed zone

In addition to the above, good management in the Gleyed zone includes measures for reducing the effects of artificial drainage and overflow drainage.

Reduce the effects of artificial drainage by:

- Protecting soil structure, particularly in gullies and near stream areas
- Reducing phosphorus use and loss
- Reducing the accumulation of surplus nitrogen in the soil, particularly during autumn and winter
- Avoiding preferential flow of effluent through drains
- Capturing contaminants at drainage outflows

Reduce the effects of overland flow by:

- Protecting soil structure, particularly in gullies and near stream areas
- Managing critical source areas (CSA)
- Reducing phosphorus use or loss

Physiographic zones and the Southland Water and Land Plan

Environment Southland has developed a proposed Southland Water and Land Plan, using the science behind the physiographic zones to inform the plan and provide a tailored approach to particular issues that have been identified for each zone.

The main aim of the plan is to introduce new methods that help to halt any further decline in water quality by managing activities that we know adversely affect the quality of Southland's freshwater – such as land use intensification, wintering and stock in waterways. A key focus of the changes is to shift all land owners towards good management practices in ways that will give the best gains for maintaining water quality.

Further information

For more information about physiographic zones and good management practices contact Environment Southland. Phone 0800 76 88 45 or email service@es.govt.nz. You can also find out more about the Physiographics of Southland and your zone on our website, www.es.govt.nz

What zone is your property in? View our map online: http://bit.ly/wlp-physiographics

Soils in the Gleyed zone are poorly drained, often waterlogged and usually found in low-lying areas.

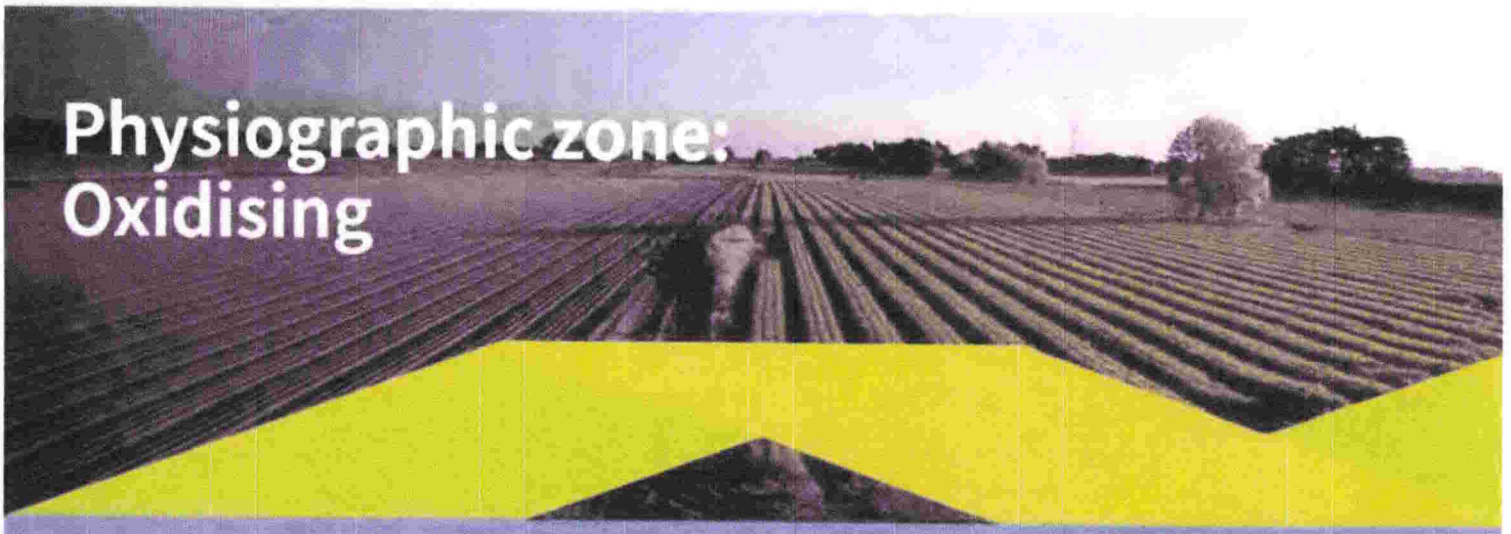
environment SOUTHLAND
REGIONAL COUNCIL
Te Taiao Tonga

Post: Private Bag 90116, Invercargill 9840 | Deliver: Cnr North Road and Price Street, Invercargill
Phone: 0800 76 88 45 | Email: service@es.govt.nz | Online: www.es.govt.nz

FACTSHEET

WATER AND LAND 2020 & BEYOND

Physiographic zone: Oxidising



Southland's physiographic zones allow us to better understand why we have variations in water quality in different areas. We've divided Southland into nine different zones according to factors such as soil type, geology and topography. Through them we can target solutions to higher risk areas as opposed to a region-wide, generalised approach.

Understanding your zone

Each zone is different in the way contaminants build up and move through the soil, areas of groundwater, and into our streams and rivers. Physiographic zones allow us to target advice and management strategies to keep farm nutrients on the farm and out of waterways.

The Physiographics of Southland project was developed as part of *Water and Land 2020 & Beyond* so we can better understand:

- where our water comes from
- how water moves through the landscape
- why we have differences in water quality across the region

What does 'Oxidising' mean?

Oxidising means well aerated, with plenty of oxygen.

The Oxidising zone is characterised by soil water and groundwater that contains high levels of oxygen, which allows nitrogen to accumulate.

Key features of the Oxidising zone

- Low elevation, flat to gently undulating land on elevated terraces along the outer margins of the major river systems.
- Also located in inland basins and some lowland areas.
- Soils and aquifers have low denitrification potential.

Water source and movement

- A high density of small streams runs through the zone, which can rise rapidly during heavy rainfall.
- Alluvial deposits contain an extensive groundwater resource.
- Drainage to waterways varies depending on slope, soil texture and permeability.
- Flat, free-draining soils: Water seeps straight down to underlying aquifers (areas of groundwater). Groundwater in this zone is 'recharged' (topped up) by rainfall that drains down through the soil.
- Slowly permeable soils may experience seasonal waterlogging. On flatter areas, they will often have artificial drainage when elevated above nearby streams. On more sloping areas, they will often have overland flow.

Contaminant movement

Groundwater in the Oxidising zone is susceptible to nitrate accumulation. Soils and underlying aquifers in the Oxidising zone have little ability to remove nitrogen (via a process called denitrification).

Streams in this zone rise rapidly during heavy rain when soils are wet. Soil water and groundwater carries with it contaminants, which continue to seep into streams after periods of heavy rain.

Oxidised soils can be very good at absorbing and storing water and any nitrogen it contains. During drier months, nitrogen is able to accumulate in soil to high levels. During winter when soils are wet, any nitrogen not used by plants leaches down into the underlying aquifer (deep drainage).

Artificial drainage (mole and tile drains) is used where soils have low subsoil permeability to help to reduce waterlogging. Contaminant loss through artificial drains to nearby streams can be high during wetter months. Overland flow may also occur during periods of heavy rain when soils are wet, especially where soils are sloping.

What does this mean for water quality?

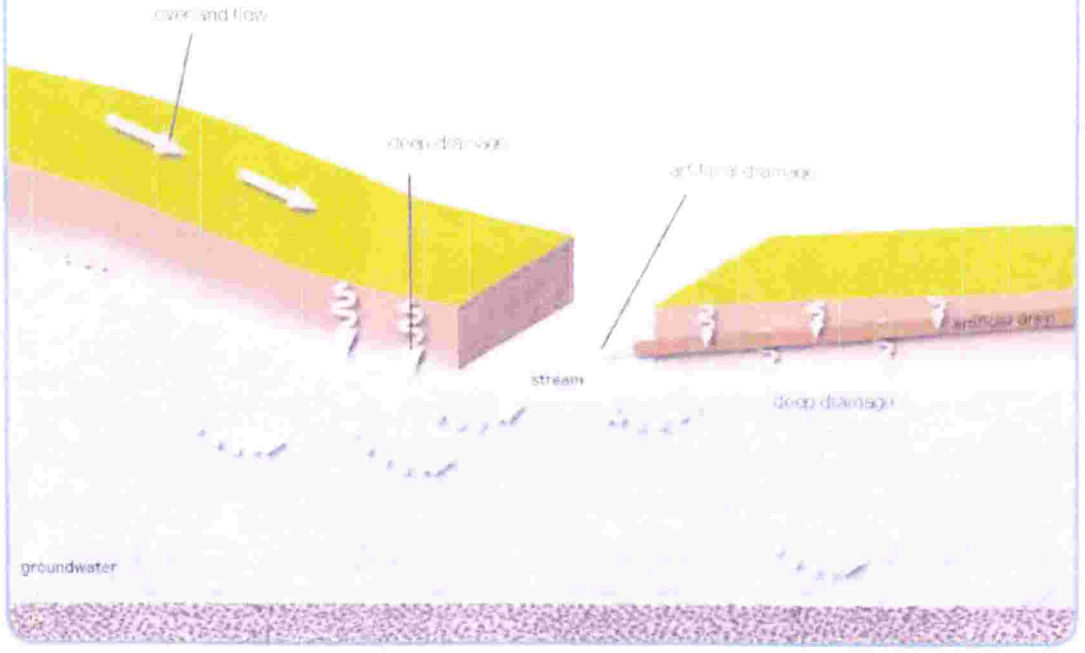
√ Soils have good phosphorus retention.

√ Limited potential for contaminant losses to rivers and streams as deep drainage is the main pathway.

X High risk of nitrogen build-up in groundwater.

X Following heavy or prolonged rainfall, contaminant losses to rivers and streams may occur via overflow or artificial drainage.

Contaminant loss during wet months



Deep drainage (leaching) of nitrogen to groundwater is the main contaminant pathway in this zone. Artificial drainage and overland flow are also important contaminant pathways in some parts of the zone and can carry nitrogen, phosphorus, sediment and microbes.

Improving water quality

The following good management practices are applicable to all physiographic zones in Southland.

- Capture nutrients, sediment and microbes in wetlands and sediment traps
- Nutrient management
- Riparian management
- Effluent management

Good management in the Oxidising zone

In addition to the above, good management in the Oxidising zone includes measures for reducing the effects of deep drainage, artificial drainage and overland flow.

Reduce the effects of deep drainage by reducing the accumulation of surplus nitrogen in the soil, particularly during autumn and winter.

Reduce the effects of artificial drainage by:

- Protecting soil structure, particularly in gullies and near stream areas
- Reducing phosphorus use and loss
- Reducing the accumulation of surplus nitrogen in the soil, particularly during autumn and winter
- Avoiding preferential flow of effluent through drains
- Capturing contaminants at drainage outflows

Reduce the effects of overland flow by:

- Protecting soil structure, particularly in gullies and near stream areas
- Managing critical source areas (CSA)
- Reducing phosphorus use or loss

Physiographic zones and the Southland Water and Land Plan

Environment Southland has developed a proposed Southland Water and Land Plan, using the science behind the physiographic zones to inform the plan and provide a tailored approach to particular issues that have been identified for each zone.

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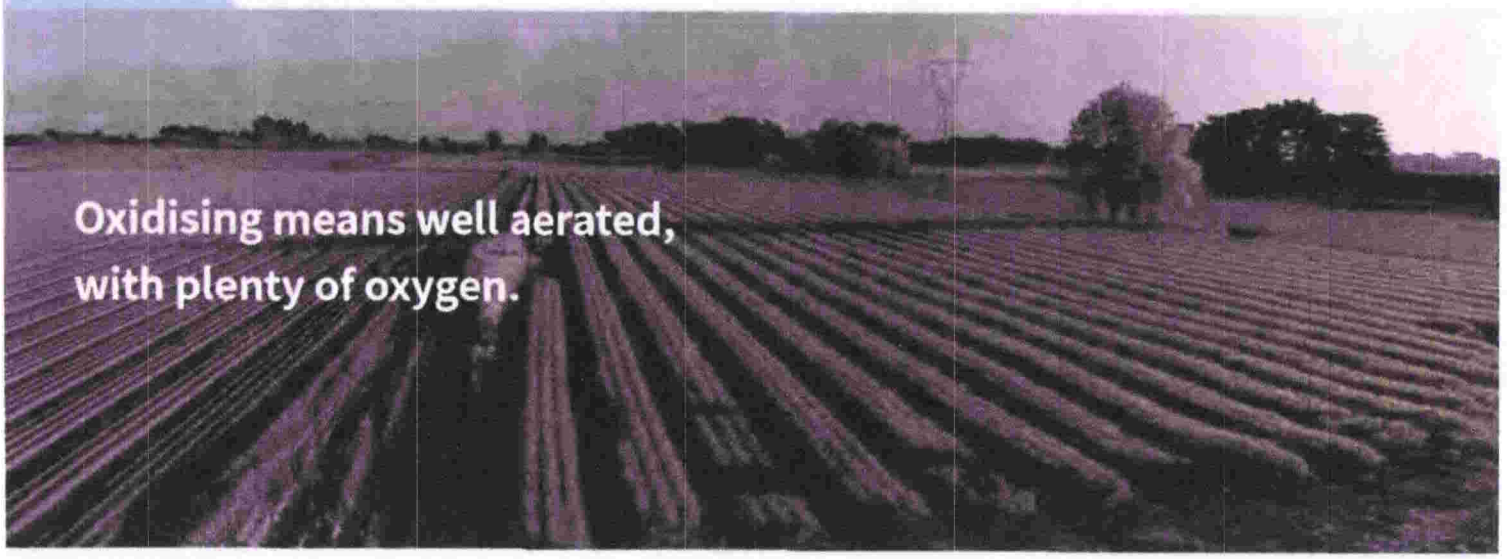
What zone is your property in? View our map online: [Physiographic zones and landscapes]



Oxidising means well aerated, with plenty of oxygen.

environment SOUTHLAND
Te Taiao Tonga

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Soil name: Pukemutu

Overview

Pukemutu soils occupy about 47,600 hectares on high terraces south of the Taringatura and Hokonui hills, extending across the Southland Plain. They also occur intermittently north of the Hokonui Hills on dissected terraces and fans from Mandeville to Mossburn. They are formed in deep loess derived from tuffaceous greywacke. They have heavy silt loam, grading with depth to silty clay, textures and are poorly drained, with a dense fragipan between 60 and 90cm depth which restricts water drainage. They respond well to mole and tile drainage and are used for intensive sheep, dairy and deer production, with some cropping. Regular summer rainfall occurs, though inland soils may be seasonally dry.

Pukemutu profile

Physical properties

Pukemutu soils have a moderately deep potential rooting depth that is severely restricted by the fragipan at 60-90 cm depth. The depth of the fragipan means the Pukemutu soils typically have moderately high to high plant available water. The soils are poorly drained, with very slow permeability in the subsoil and limited aeration during sustained wet periods. Textures are typically heavy silt loams, increasing to silty clay in the lower subsoil. Topsoil clay content is typically 25–30%, and stone free. The moderately deep variants have gravel between 45 and 90cm depth.

Fertility properties

Organic matter values range from 4 to 6%; P-retention values under 30%; pH values above 5.5 but tend to decline down the profile. Cation exchange values are low, with base saturation increasing in the subsoil, which also has higher magnesium values than the topsoil. Values for available calcium, potassium and sodium are low. Phosphorus reserves are low and sulphur levels increase in the subsoil. Good responses to lime and phosphate occur. Micro-nutrient levels are generally adequate, although boron responses in brassicas and molybdenum responses in legumes can occur.

Associated and similar soils

Some soils that commonly occur in association with Pukemutu soils are:

- Braxton: moderately deep to deep Gley soil on terraces with heavy silt loam to clayey textures; has no perch-gley properties or fragipan within 90cm depth
- Makarewa: Gley soil with clayey textures on the floodplain
- Woodlands: imperfectly drained Brown soil without a fragipan
- Tisbury: Gley soil on terraces of the Southland Plain; has silty textures throughout and is strongly leached, with moderate to high P-retention; has no perch-gley properties or fragipan within 90cm depth.

Some soils that have similar properties to Pukemutu soils are:

- Aparima: imperfectly drained equivalent of the Pukemutu soil
- Mossburn: similar profile form to Pukemutu, but has siltier textures throughout the profile; formed in mixed loess and colluvium on fans flanking the Taringatura Hills; commonly has stones scattered through the profile
- Waikoikoi: has silty textures throughout the profile; fragipan has prismatic structure and occurs at a shallower depth (45–60cm)
- Hokonui: has clayey textures, and formed in mixed loess and alluvium on fans from the Hokonui Hills; has perch-gley properties but not fragipan.

Sustainable management indicators

Note: the vulnerability ratings given in the table below are generalised and should not be taken as absolutes for this soil type in all situations. The actual risk depends on the environmental and management conditions prevailing at a particular place and time. Specialist advice should be sought before making management decisions that may have environmental impacts. Where vulnerability ratings of Moderate to Very severe are indicated, advice may be sought from Environment Southland or a farm management consultant.

Vulnerability factor	Rating	Vulnerability compared to other Southland soils
Structural compaction	Severe	These soils have a severe vulnerability to structural degradation by long-term cultivation, or compaction by heavy stocking and vehicles. This rating reflects the poor drainage, low clay and P-retention in the topsoil that results in low structural stability.
Nutrient leaching	Slight	These soils have a slight vulnerability of leaching to ground water. The vulnerability is strongly influenced by the moderately high water-holding capacity and the slow permeability of the subsoil. Lateral water flow in installed mole and tile drains would increase losses.
Topsoil erodibility by water	Moderate	Due to the low clay content, the topsoil erodibility of these soils is moderate. Erodibility is highly dependent on management, especially when there is no vegetation cover.
Organic matter loss	Slight	Vulnerability to long-term decline in soil organic matter levels is partly dependent on soil properties, and highly dependent on management practices (e.g., crop residue management and cultivation practices)
Waterlogging	Severe	These soils have severe vulnerability to waterlogging during wet periods. This rating reflects the poor drainage and slow permeability.

General landuse versatility ratings

Note: The versatility ratings in the table below are indicative of the major limitations for semi-intensive to intensive land use. These ratings differ from those used in the past in that sustainability factors are incorporated in the classification. Refer to the Topoclimate district soil map or property soil map to determine which of the soil symbols listed below are applicable, then check the versatility ratings for that symbol in the appropriate table.

PgU1 (Pukemutu undulating deep); PgU1vf (Pukemutu undulating deep flood plain variant); PgU2 (Pukemutu undulating moderately deep); PgU2vf (Pukemutu undulating moderately deep flood plain variant); PgR1 (Pukemutu rolling deep)

Versatility evaluation for soil PgU1, PgU1vf, PgU2, PgU2vf		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Limited	Inadequate aeration during wet periods; risk of short-term waterlogging after heavy rainfall.
Arable	Limited	Inadequate aeration during wet periods; risk of short-term waterlogging after heavy rainfall.
Intensive pasture	Limited	Risk of short-term waterlogging after heavy rainfall.
Forestry	Limited	Inadequate aeration during wet periods; vulnerability to sustained waterlogging.

Note: rolling slopes are an additional limitation for arable landuse on PgR1 soils

PgH1 (Pukemutu hilly deep)

Versatility evaluation for soil PgH1		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Unsuitable	Hilly slopes
Arable	Unsuitable	Hilly slopes
Intensive pasture	Limited	Hilly slopes; risk of short-term waterlogging after heavy rain.
Forestry	Limited	Inadequate aeration during wet periods.

Management practices that may improve soil versatility

- Careful management after heavy rain and wet periods will reduce the impact of short-term waterlogging. Intensive stocking, cultivation and heavy vehicular traffic should be minimised during these periods.
- Installation and maintenance of sub-surface mole and tile drains will reduce the risk of short-term waterlogging.
- If compaction occurs, aeration at the correct depth and moisture condition can be of benefit.

Soil name: Edendale

Overview

Edendale soils occupy 9,700 ha of land on gently sloping to undulating intermediate terraces in the lower Mataura and Oreti river valleys. They are formed in deep wind-blown loess derived from greywacke and schist rocks. Edendale soils are well drained and have a deep rooting depth, high water-holding capacity, and silt loam textures. They are high producing soils currently used for intensive sheep, dairy and deer production, with limited cropping. They have a cool temperate climate with rain over the year and seldom dry out.

Edendale profile

Physical properties

Edendale soils have a deep rooting depth and high plant-available water, meaning there is no significant physical barrier to root growth. The soils are well drained but the compact subsoil is slowly permeable, and may cause short-term waterlogging after heavy rainfall. Texture is silt loam in all horizons, with topsoil clay content of 25-30%. Edendale soils are typically stone free, although the moderately deep phases have gravels between 45 and 90cm depth that may restrict rooting depth and available water to moderately high.

Fertility properties

Topsoil organic matter levels are 10-15%, P retention values 55-75%, pH values are usually above 5.5 in all horizons, with moderate cation exchange capacity and base saturation values. Natural reserves of P, K, Mg, and S are moderate to high. Soils respond well to lime and phosphate. Potassium and nitrogen are required in intensive use situations. Micro-nutrient levels are generally adequate, although boron responses in brassicas and molybdenum responses in legumes can occur.

Associated and similar soils

Some soils that commonly occur in association with Edendale soils are:

- Mokotua: imperfectly drained soils on the same landform west of Invercargill
- Arthurton: imperfectly drained soils on the same landform in the Edendale township area
- Waikoikoi: poorly drained soils on low terraces and foot slopes of adjacent high terraces
- Jacobstown: poorly drained soils on floodplains.

Some soils that have similar properties to Edendale soils are:

- Clinton: occur on undulating fans west of Clinton township; have P-retention of 30-45% throughout profile.
- Pourakino: occur on the flanks of the Pourakino Valley; paler colours; P-retention 70-85% throughout profile.
- Waikiwi: very similar soil profile; occur on high terraces of the Southland Plains.
- Waimatuku: very similar soil profile; occur on high terraces of the Southland Plains west of the Waimatuku Stream; have a distinct subsoil fragipan.

Sustainable management indicators

Note: the vulnerability ratings given in the table below are generalised and should not be taken as absolutes for this soil type in all situations. The actual risk depends on the environmental and management conditions prevailing at a particular place and time. Specialist advice should be sought before making management decisions that may have environmental impacts. Where vulnerability ratings of Moderate to Very severe are indicated, advice may be sought from Environment Southland or a farm management consultant.

Vulnerability factor	Rating	Vulnerability compared to other Southland soils
Structural compaction	slight	These soils have a slight vulnerability to structural degradation by long-term cultivation, or compaction by heavy stocking and vehicles. This rating reflects the good drainage and the topsoil clay and P-retention values.
Nutrient leaching	moderate	These soils have a moderate vulnerability to leaching to groundwater. This rating reflects the moderately high water-holding capacity and slow subsoil permeability offset by the good profile drainage.
Topsoil erodibility by water	slight	Due to the clay content, topsoil erodibility in these soils is slight. Erodibility is highly dependent on management, particularly when there is no vegetation cover.
Organic matter loss	minimal	Vulnerability to long-term decline in soil organic matter levels is partly dependent on soil properties and highly dependent on management practices (e.g., crop residue management and cultivation practices).
Waterlogging	slight	These soils have a slight vulnerability to waterlogging during wet periods. This rating reflects the good drainage but slowly permeable subsoil.

General landuse versatility ratings

Note: The versatility ratings in the table below are indicative of the major limitations for semi-intensive to intensive land use. These rating differ from those used in the past in that sustainability factors are incorporated in the classification. Refer to the Topoclimate district soil map or property soil map to determine which of the soil symbols listed below are applicable, then check the versatility ratings for that symbol in the appropriate table.

EdU1 (Edendale undulating deep)
EdU1vi (Edendale undulating deep, imperfectly drained variant)

Versatility evaluation for soil EdU1, EdU1vi		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Moderate	Short-term waterlogging after heavy rain
Arable	Moderate	Short-term waterlogging after heavy rain
Intensive pasture	High	Vulnerability to leaching to groundwater
Forestry	High	Few limitations

EdU2 (Edendale undulating moderately deep): as above, except that forestry landuse versatility rating is only moderate, due to restricted rooting depth.

EdR1 (Edendale rolling deep)

Versatility evaluation for soil EdR1		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Moderate	Rolling slopes; risk of short-term waterlogging after heavy rain
Arable	Limited	Rolling slopes
Intensive pasture	High	Rolling slopes; vulnerability to leaching to groundwater
Forestry	High	Few limitations

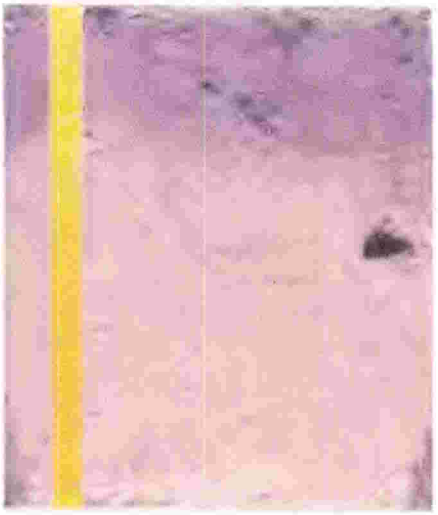
Management practices that may improve soil versatility

- Careful management after heavy rainfall and wet periods will reduce the impact of short-term waterlogging. Intensive stocking, cultivation and vehicular traffic should be minimised during these periods.
- Installation and maintenance of subsurface drainage with moles and tiles may reduce the risk of short-term waterlogging
- If compaction occurs, aerating at the correct depth and moisture condition can be of benefit.

Soil name: Waianiwa

Overview

Waianiwa soils occupy about 1,500 ha on intermediate and high terraces of the Southland Plain between Riverton and Hedgehope. They are formed in deep loess deposits derived from tuffaceous greywacke rock. They have heavy silt loam textures, and are imperfectly drained, with a dense fragipan between 60 and 90cm depth which restricts water drainage. Waianiwa series was orginally defined and published prior to the investigation of the Aparima map units, and should be correlated into the Aparima soils. They respond well to mole and tile drainage and are used for intensive sheep, dairy and deer production with some cropping. Regular summer rainfall occurs though inland soils may be seasonally dry.



Waianiwa profile

Physical properties

Waianiwa soils have a moderately deep rooting depth that is restricted by the fragipan at 60-90cm depth. The depth of the fragipan means the Waianiwa soils typically have moderately high to high plant available water. The soils are imperfectly drained with slow permeability through the fragipan. Textures are heavy silt loams but tend towards silty clays in the lower subsoil. Topsoil clay content is 20-30%, and stonefree.

Fertility properties

Topsoil organic matter level is about 7%, P-retention 25-30% and pH values moderate (high 5s). Subsoil pH values are low (low 5s). Cation exchange values are moderate and base saturation values high. Available calcium is high, with magnesium and potassium low. Soil reserve phosphorus is low. Micronutrient values are generally adequate.

Associated and similar soils

Some soils that commonly occur in association with Waianiwa soils are:

- Oteramika: shallow soil occurring on shoulder and side slopes where loess has been eroded away
- Waikiwi: well drained deep Brown soil
- Pebbly Hills: shallow soil forming into quartz gravels

Some soils that have similar properties to Waianiwa soils are:

- Aparima: same soil - Waianiwa should be correlated into the Aparima series. Waianiwa series was orginally defined and published prior to the investigation of the Aparima map units. Occurs on high terraces east of the Aparima River.
- Pukemutu: poorly drained equivalent of the Aparima soil
- Woodlands: imperfectly drained Brown soil without a fragipan

Sustainable management indicators

Note: the vulnerability ratings given in the table below are generalised and should not be taken as absolutes for this soil type in all situations. The actual risk depends on the environmental and management conditions prevailing at a particular place and time. Specialist advice should be sought before making management decisions that may have environmental impacts. Where vulnerability ratings of Moderate to Very severe are indicated, advice may be sought from Environment Southland or a farm management consultant.

Vulnerability factor	Rating	Vulnerability compared to other Southland soils
Structural compaction	moderate	These soils have a moderate vulnerability to structural degradation by long-term cultivation, or compaction by heavy stocking and vehicles. This rating reflects the imperfect drainage and medium P-retention.
Nutrient leaching	moderate	These soils have a moderate vulnerability to leaching to groundwater. This rating reflects the imperfect drainage, slow subsoil permeability and moderately high water-holding capacity.
Topsoil erodibility by water	slight	Due to the moderate clay and organic matter levels, topsoil erodibility in these soils is slight. Erodibility is highly dependent on management, particularly when there is no vegetation cover.
Organic matter loss	slight	Vulnerability to long-term decline in soil organic matter levels is partly dependent on soil properties and highly dependent on management practices (e.g., crop residue management and cultivation practices).
Waterlogging	moderate	These soils have a moderate vulnerability to waterlogging during wet periods. This rating reflects the imperfect drainage and slow permeability.

General landuse versatility ratings

Note: The versatility ratings in the table below are indicative of the major limitations for semi-intensive to intensive land use. These ratings differ from those used in the past in that sustainability factors are incorporated in the classification. Refer to the Topoclimate district soil map or property soil map to determine which of the soil symbols listed below are applicable, then check the versatility ratings for that symbol in the appropriate table.

WbU1 (Waianiwa undulating deep) and WbU2 (Waianiwa undulating moderately deep)

Versatility evaluation for soil WbU1, WbU2		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Moderate	Risk of short-term waterlogging after heavy rain; restricted rooting depth
Arable	Moderate	Inadequate aeration during wet periods; vulnerability to structural compaction
Intensive pasture	Moderate	Inadequate aeration during wet periods; vulnerability to structural compaction
Forestry	Moderate	Vulnerability to sustained waterlogging , restricted rooting depth

WbR1 (Waianiwa rolling deep): as above, but limited versatility for arable landuse due to rolling slopes.

WbS1 (Waianiwa steep deep)

Versatility evaluation for soil WbS1		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Unsuitable	Steep slopes
Arable	Unsuitable	Steep slopes
Intensive pasture	Limited	Steep slopes
Forestry	Limited	Steep slopes; restricted rooting depth

Management practices that may improve soil versatility

- Careful management after heavy rain and wet periods will reduce the impact of short-term waterlogging. Intensive stocking , cultivation and heavy vehicular traffic use should be minimised during these periods.
- Installation and maintenance of subsurface mole and tile drains will reduce the risk of short-term waterlogging.
- If compaction occurs, aeration at the correct moisture condition and depth can be of benefit.

Soil name: Northope

Overview

Northope soils occupy about 1,600 ha on the flood plains and low terraces of the Oreti River south of Benmore. They are formed in dominantly deep fine alluvium, with gravel occurring below 45cm in some places. Northope soils have heavy silt loam texture and imperfect drainage, causing limited seasonal wetness. Northope soils are suitable for a wide range of farming activities and receive regular summer rainfall.

Northope profile

Physical properties

Northope soils have no rooting barrier, but have high bulk density that limits the degree of subsoil root growth. Aeration is limited for parts of the year. Textures are generally heavy silt loam to silty clay, with clay content of 30–40% in the topsoil. They are dominantly gravel free, although moderately deep soils do have gravelly layers below 45cm depth.

Fertility properties

Topsoil organic matter levels are 4–6%; P-retention values mostly under 30%; pH values are moderate and tend to increase down the profile. Cation exchange values are moderate and base saturation values high, as are calcium values, reflecting the influence of limestone outcrops upstream of these soils. Reserves of phosphorus, potassium, sulphur and nitrogen are low, with good pasture and crop responses to these nutrients. Micro-nutrient levels are generally adequate.

Associated and similar soils

Some soils that commonly occur in association with Northope soils are:

- Riversdale: well drained, shallow soils with gravel at less than 45cm depth
- Mataura: found on the active, accumulating floodplain. Classified as Recent soils with no B horizon development in the subsoil
- Makarewa: poorly drained
- Caroline: poorly drained, with an iron pan

Some soils that have similar properties to Northope soils are:

- Winton: well drained equivalent of the Northope soil
- Ardlussa: well drained, and textures are generally not heavy silt loams. Classified as Brown soils with P-retention of greater than 30%

Sustainable management indicators

Note: the vulnerability ratings given in the table below are generalised and should not be taken as absolutes for this soil type in all situations. The actual risk depends on the environmental and management conditions prevailing at a particular place and time. Specialist advice should be sought before making management decisions that may have environmental impacts. Where vulnerability ratings of Moderate to Very severe are indicated, advice may be sought from Environment Southland or a farm management consultant.

Vulnerability factor	Rating	Vulnerability compared to other Southland soils
Structural compaction	Severe	These soils have a severe vulnerability to structural degradation by long-term cultivation, or compaction by heavy stocking and vehicles. This rating reflects the imperfect drainage and low P-retention.
Nutrient leaching	Moderate	These soils have a moderate vulnerability to leaching to groundwater. The vulnerability will vary, depending on the amount of gravel in the subsoil, which determines the subsoil water holding capacity.
Topsoil erodibility by water	Slight	Due to the heavy silt loam texture, the topsoil erodibility of these soils is slight. Erodibility is highly dependent on management, particularly when there is no vegetation cover.
Organic matter loss	Slight	Vulnerability to long-term decline in soil organic matter levels is partly dependent on soil properties, and highly dependent on management practices (e.g., crop residue management and cultivation practices).
Waterlogging	Moderate	These soils have a moderate vulnerability to waterlogging during wet periods. This rating reflects the imperfect drainage and undulating slopes.

General landuse versatility ratings

Note: The versatility ratings in the table below are indicative of the major limitations for semi-intensive to intensive land use. These ratings differ from those used in the past in that sustainability factors are incorporated in the classification. Refer to the Topoclimate district soil map or property soil map to determine which of the soil symbols listed below are applicable, then check the versatility ratings for that symbol in the appropriate table.

NhU1 (Northope undulating deep)
NhU2 (Northope undulating moderately deep)

Versatility evaluation for soil NhU1 and NhU2		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Moderate	Inadequate aeration for sustained periods; restricted subsoil root penetrability
Arable	Moderate	Aeration in winter/early spring and structural vulnerability to compaction with continuous cropping
Intensive pasture	Moderate	Aeration in winter/early spring and structural vulnerability to compaction with continuous cropping
Forestry	Limited	Flooding for long term crops

Management practices that may improve soil versatility

- Flood protection
- Installation of artificial drainage to remove excess water during wet periods.
- Careful management of stocking and minimal cultivation when soils are wet.

Lower Oreti

GROUNDWATER ZONE INFORMATION SHEET

Groundwater zone:	Lower Oreti
Aquifer type:	Lowland
Size:	41,155 ha
Allocation status:	Low

Extent

The Lower Oreti groundwater zone encompasses the recent floodplain of the Oreti River south of Ram Hill. North of Centre Bush the lateral extent is constrained by the basement rock exposed in the Hokonui and Taringatura Hills. The eastern and western boundaries of the lower portion of the Lower Oreti groundwater zone follow the alluvial terraces which mark the extent of the Q1 and Q2 gravel sequences of the recent Oreti River floodplain.

Groundwater Quality

Groundwater quality is generally good in the Lower Oreti groundwater zone, although it does vary with location and depth. Groundwater in the gravel deposits can be susceptible to nutrient enrichment, although generally remains within the acceptable limits set by the drinking water standards. Groundwater that is sourced from the deeper Tertiary aquifers can contain high iron, which is characteristic of the mudstone and lignite geology.

Poor wellhead protection is a significant issue in Southland. Inappropriate location, construction and maintaince of bores and wells can lead to localised groundwater contamination, particularly in regards to bacterial and nutrient concentrations. If you are concerned about your bore or would like to know more, please contact Environment Southland or visit our website.

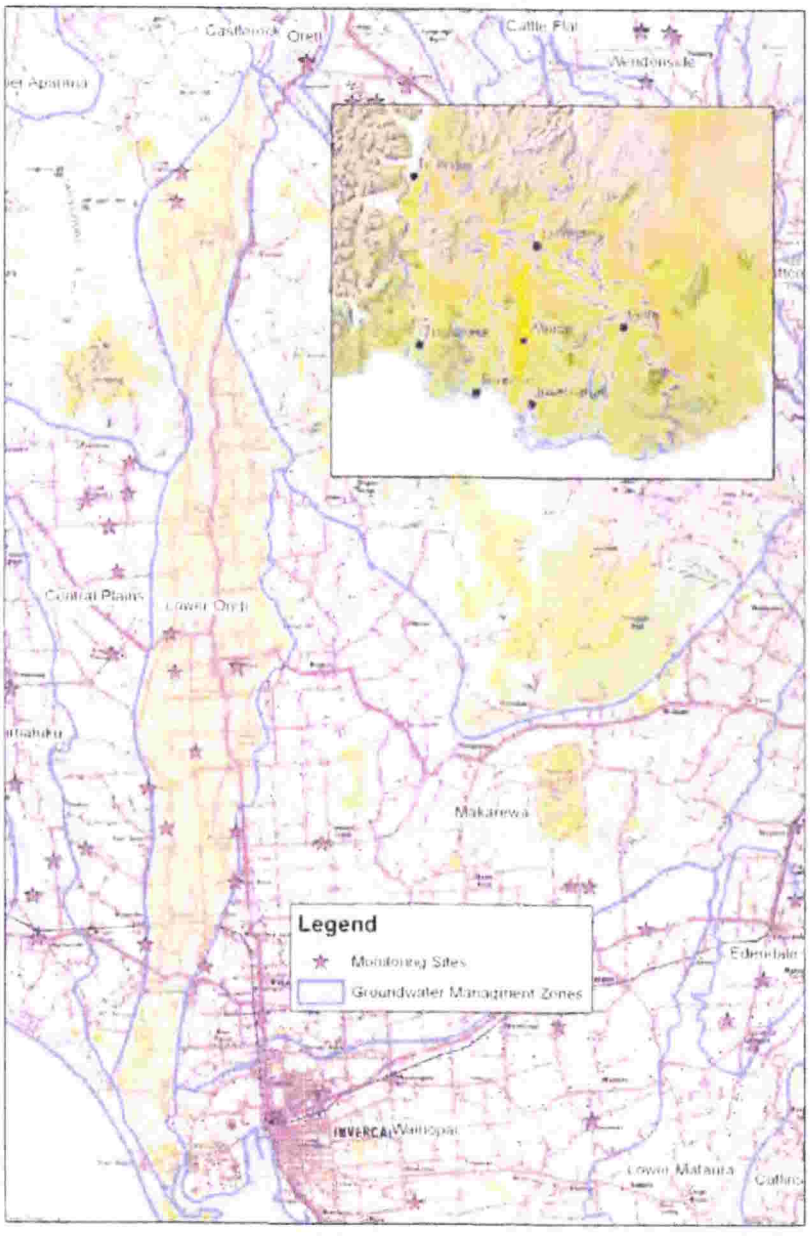


Figure 1: Map of the Lower Oreti Groundwater Zone (at right).

Lower Oreti

GROUNDWATER ZONE INFORMATION SHEET

Hydrogeology

The subsurface geology of the Lower Oreti Groundwater zone consists of a relatively thin layer of Quaternary gravels overlying Tertiary deposits of the Forest and Winton Hill Formations north of Forest Hill, and the Gore Lignite Measures to the south. The thickness of the gravel deposits appears to decrease towards the south, with greater than 40 metres Quaternary gavels recorded the vicinity of Dipton, decreasing to 20-30 metres in the Centre Bush-Winton area to less than 10 metres in the Wallacetown area. The gravel deposits are generally poorly sorted and are claybound over much of the Lower Oreti groundwater zone and form a poorly stratified unconfined aquifer system. Available specific capacity and aquifer test information indicate the relatively low permeability across the entire system.

The underlying sediments of the Winton Hill Formation are largely unknown with very little drilling below the Quaternary gravel deposits recorded in this area.

Seasonal groundwater level fluctuations show the characteristic sharply peaked response characteristic of Lowland aquifers, although in some areas groundwater levels indicate interaction between the Oreti River and adjacent unconfined aquifer along the riparian margins. This is apparent to the west and north of Winton however, elsewhere in the catchment (e.g. south of Lochiel) the bed of the Oreti is sufficiently incised into the Quaternary gravels and underlying Tertiary sediments to result in the surrounding unconfined aquifer being perched above river level.

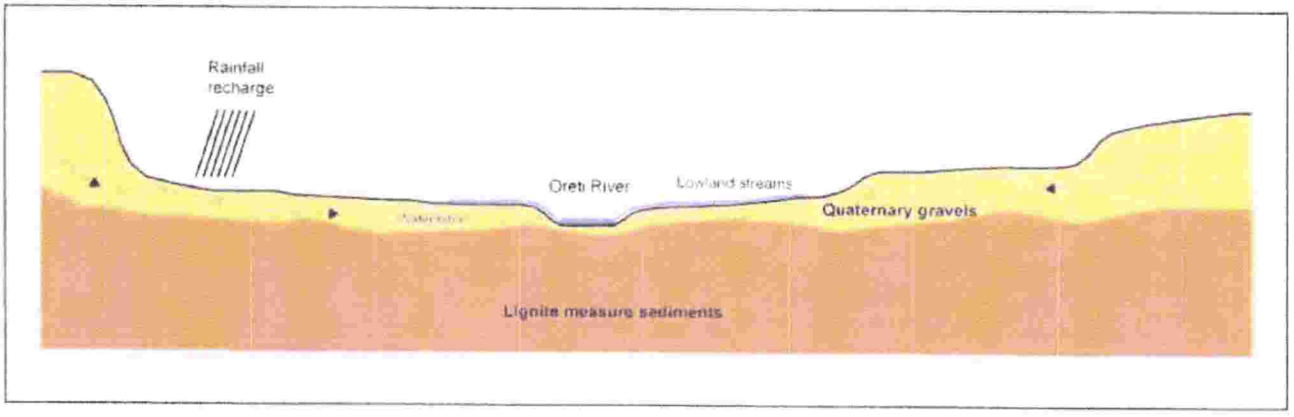


Figure 2: Schematic cross-section of the Lower Oreti Groundwater Zone.

Recharge and discharge

Recharge to aquifers in the Lower Oreti groundwater zone is principally derived from rainfall infiltration. Lincoln Environmental estimated mean annual land surface recharge in the Lower Oreti groundwater zone at 368 mm/year. Some local groundwater/surface water interaction may also occur along the many small streams that cross the Oreti floodplain and the riparian margin of the Oreti River.

Groundwater discharge from the Lower Oreti Groundwater zone occurs via small contact springs and influent streams which cross the Oreti River floodplain.

Makarewa

GROUNDWATER ZONE INFORMATION SHEET

Groundwater zone:	Makarewa
Aquifer type:	Lowland
Size:	78,924 ha
Allocation status:	Low

Extent

The extent of the Makarewa groundwater zone largely follows the boundary of the Makarewa River catchment on the eastern Southland Plains as far north as the break in slope at the foot of the Hokonui Hills.

Groundwater Quality

Groundwater quality is generally good in the Makarewa groundwater zone, although it does vary according to the source aquifer and location. Groundwater in the gravel deposits can be susceptible to nutrient enrichment, although does generally remain within the acceptable limits set by the drinking water standards. Groundwater that is sourced from the Tertiary aquifers can contain high iron concentrations, which is characteristic of the mudstone and lignite geology.

Poor wellhead protection is a significant issue in Southland. Inappropriate location, construction and maintenance of bores and wells can lead to localised groundwater contamination, particularly in regards to bacterial and nutrient concentrations. If you are concerned about your bore or would like to know more, please contact Environment Southland or visit our website.

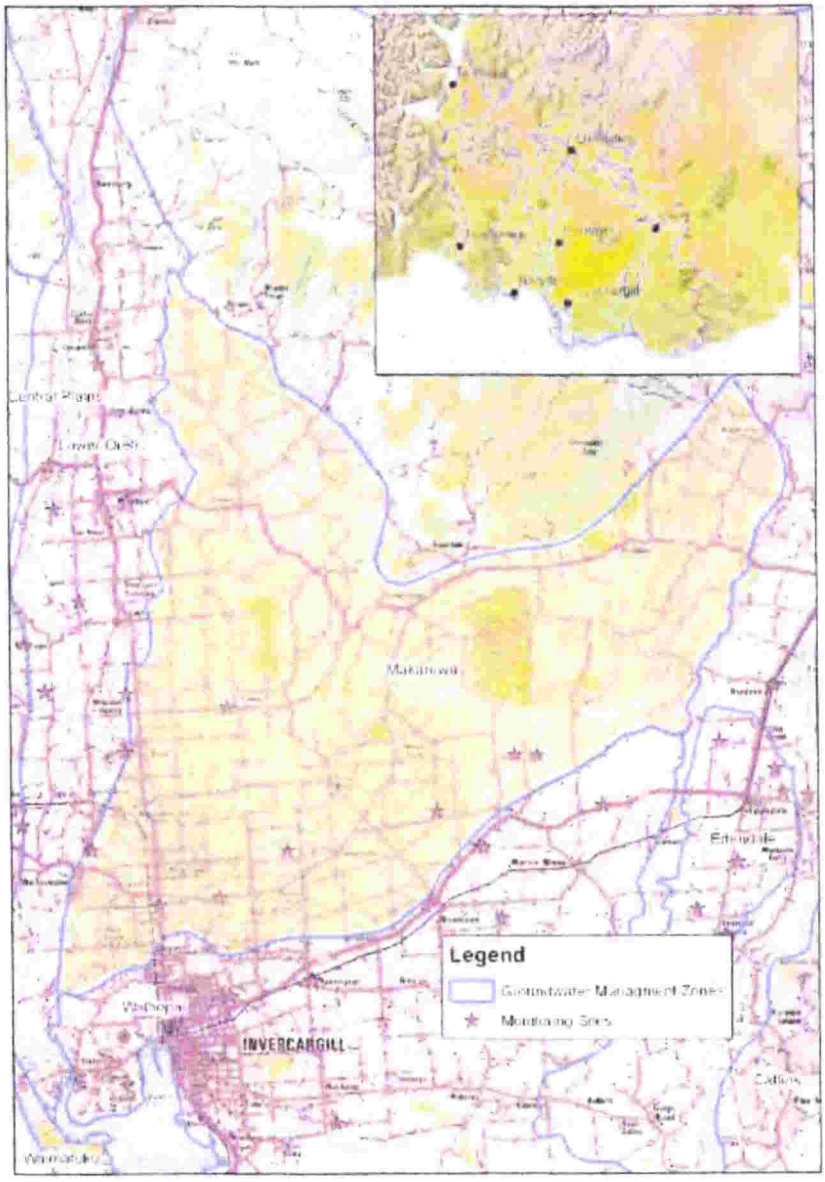


Figure 1: Map of the Makarewa Groundwater Zone (above).

Makarewa

GROUNDWATER ZONE INFORMATION SHEET

Hydrogeology

The subsurface geology of the Makarewa groundwater zone consists of relatively thin Quaternary gravel deposits overlying Tertiary Gore Lignite Measure sediments.

The gravel deposits vary in thickness from <5 metres to 30 metres, increasing in thickness under ridges in the undulating topography. The gravel deposits are comprised of moderately to well rounded quartz gravels in a weathered clay matrix. Exposure in gravel pits around the Grove Bush/Mabel Bush areas illustrate the tightly claybound nature of the gravel materials and the relatively thick loess deposits formed on these mid-Quaternary glacial outwash materials deposited by the ancestral Mataura River.

Across the undulating topography, groundwater levels in the unconfined aquifer may be close to the land surface adjacent to rivers and streams but occur at some depth beneath intervening ridges, with the water table ranging between 2 to 10 metres below ground. This pattern results in a piezometric surface that broadly follows the topographic surface and creates local gradient toward the nearest surface water feature.

Seasonal hydrographs recorded in the Makarewa groundwater zone show the typical peaked response characteristic of lowland aquifers. Groundwater levels increase rapidly in mid-winter with the onset of soil moisture recharge then decline in an almost linear fashion for the remainder of the year as groundwater is progressively drained by local first and second order streams.

While localised areas of higher permeability may exist adjacent to main river channels, due to the highly weathered nature of the matrix material in the Quaternary gravel deposits; aquifer permeability is uniformly low across a majority of the Makarewa groundwater zone. Bores screened in the Quaternary gravel aquifer are typically low-yielding with recorded specific capacity values commonly less than 25 m^3/day/m. Specific capacity values are particularly low in the Woodlands/Grove Bush/Dacre area.

The underlying lignite measure sediments form an extensive, poorly defined confined aquifer system throughout a majority of the Makarewa groundwater zone. The lignite measure sediments appear to be largely dominated by thick mudstone deposits around the Invercargill and Otapiri areas, however to the north and east many bore logs indicate the presence significant thicknesses of waterbearing quartzose gravel and sand. Artesian flows are recorded from confined lignite measure aquifers in the Hedgehope area.

Recharge and discharge

Recharge to the Makarewa groundwater zone is exclusively from rainfall recharge with Lincoln Environmental estimating annual land surface recharge at 436 mm/year. The extensive land drainage by mole, tile and artificial drainage channels may have a significant influence on the actual rate of groundwater recharge in many parts of the Makarewa groundwater zone.

A majority of groundwater is discharged by local infiltration into drainage channels and first and second order streams.

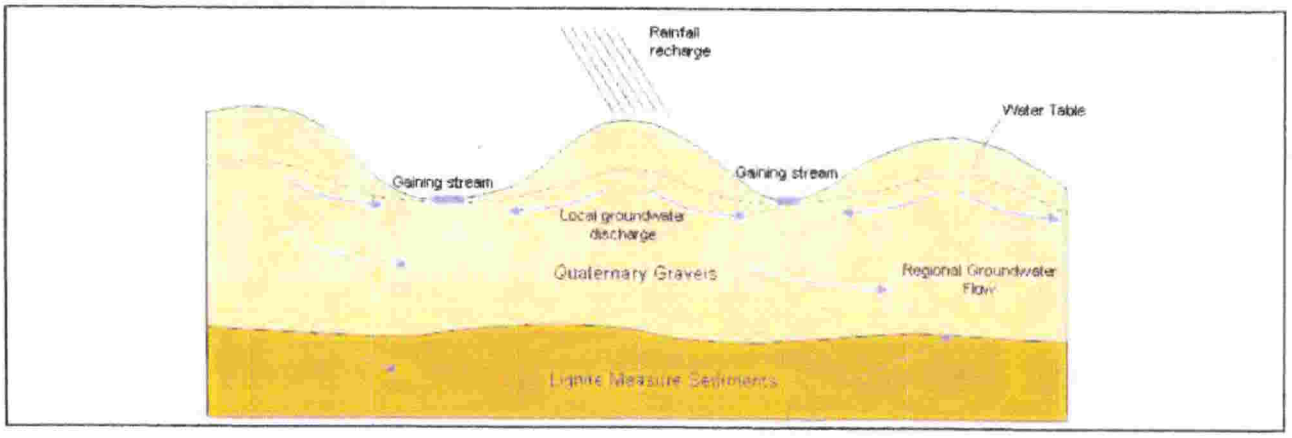


Figure 2: Schematic cross-section of the Makarewa Groundwater Zone (above).

Appendix 8 Scale of effects of urinary N from Heifers, Calves and Cows

The scale of effects, particularly urinary N from the heifers, calves and cows is estimated below. The amount of estimated urinary N per calf and hectare of 90g N per day has been based on the meta analysis that follows. It is considered conservative given the current research is limited to measurements for heifers aged 6-11 months in age and 150-200kg in weight. It is expected the urinary N per heifer will be higher than this value, particularly as they approach full live weight of 400-500kg.

Current scenario

	Urinary N (g / day / head)	Number	Days	total N (kg/day)	total N / year (kg)
Calves	90	170	365	15.3	5,585
Heifers	90	140	365	12.6	4,599
Cows (wintered 68d)	438	200	68	87.6	5,957
Totals				27.9	16,140

Proposed scenario

	Urinary N (g / day / head)	Number	Days	total N (kg/day)	total N / year (kg)
Dairy cows (150 for 300 days)	438	150	300	65.7	19,710
Wintered cows (200 for 23 days)	438	200	23	87.6	2,015
Totals				65.7	21,725

Mitigations

	Urinary N (g / day / head)	Number	Days	total N (kg/day)	total N / year (kg)
Dairy cows (wintered off)	438	599	84	262.362	22,038

Meta-analysis of heifer and calf total urinary N loss

Only a handful of studies have been undertaken that measure or estimate the urinary concentration, volume and total N loss of immature dairy cows to land. The following literature review has been undertaken to support the estimation of total urinary N loss on the South Dairy farm, and includes the recent published research projects undertaken on farms in New Zealand.

The range of measured and estimated N loss for a calves was from 42-106 g per heifer per day, for samples that ranged in age from 6-11 months, and average weights between 144 and 210kg.

No research on N loss has been located for heifers between the ages 12 to 24 months.

Study	Heifer age (months)	Weight (kg)	Urinary N loss (g / day)
Edwards (2014)	6	144	42
Judson & Edwards	8	180	106*

(2016)			
Cheng et al (2015)	9-10	210	70
Cheng et al (2016)	9-11	184	99
Carr (2015)	8-9	176	

* calculated based on a measured on an average urine concentration of 0.53%.

References

Carr, H. (2015). *Live weight gain and urinary nitrogen excretion of dairy heifers grazing pasture, chicory and plantain* (Doctoral dissertation, Lincoln University).

Cheng, L., McCormick, J., Hussein, A. N., Fraslin, C., Moonsan, Y., Logan, C., Grabot J. & Edwards, G. R. (2015). Urinary nitrogen excretion, grazing and urination behaviour of dairy heifers grazing pasture, chicory and plantain in autumn. In *Proceedings of New Zealand Society of Animal Production* (Vol. 75, pp. 70-73).

Cheng L., McCormick J., Logan C., Hague H., Hodge M. C., Edwards G. R. (2016) Liveweight gain and urinary nitrogen excretion of dairy heifers grazing perennial ryegrass-white clover pasture, canola, and wheat. *Animal Production Science*.

EDWARDS, G. (2014). Liveweight gain and urinary nitrogen excretion of dairy heifers grazing perennial ryegrass/white clover pasture, wheat and canola. In *Proceedings of the 5th Australasian Dairy Science Symposium* (p. 309).

JUDSON, H., & EDWARDS, G. (2016). Urinary nitrogen concentration from dairy heifers grazing kale supplemented with either plantain or perennial ryegrass baleage in winter. *Journal of New Zealand Grasslands*, *78*, 99-102.

Appendix 9 Additional prior questions and answers

The following questions have been previously asked in response to the previous application or subsequent correspondence. Where they are relevant or may not be answered in full in the application above, they have been included here for reference:

Question: Environment Southland 25 May 2017:

> Given the higher groundwater nitrate-nitrogen levels in the western end of the property, and the Oxidising zone (where there is little denitrifying ability), is extending the discharge area to include this part of the farm best practise? (sorry if you addressed this and I missed it)

Answer Civil Tech 26 May 2017:

> We estimate that effluent will only amount to between 16 to 20 kg N/ha/year over the discharge area. This is detailed in Table 1 and Appendix A of the further information. On the western area there will be at least 50% less crop in comparison to what has happened over the last 5 years and this season they have also mechanically harvested the fodder beet from this area to feed during autumn instead of silage. The silage is high N so they are using a low N alternative and they will not be feeding the cows on fodder crop over winter on this area or any of the farm. The cows that grazed on grass and balage in spring can also be held on a feed/stand-off pad during wet periods. The 50% less crop will reduce the Nitrate but also not having the cows graze the crop in winter on that area during the riskiest period.

civil tech ltd

MANAGEMANT PLAN

SOUTH DAIRY LTD

373 O'SHANNESSY ROAD

Civil Tech Ltd
P O Box 1558
INVERCARGILL 9840
T: (03) 216 9745
F: (03) 216 9735
M: 0274 357 957
E: murray@civiltech.co.nz

2. 373 O'SHANNESSY ROAD

SOUTH DAIRY LTD Contact: Mr D Alexander

Legal description of land owned by South Dairy Ltd:

Pt Sec 26, 46 & 47 and sec 49, 51,52 and 53 Blk I Winton HD and Sec 10 & 11 Blk II Winton HD

Consents Held:

204476	Discharge Permit + Appendix 1
204477	Water Permit

3. Attachments

Physiographic Zones Map
Aerial Photograph
Soil Type Map

There is a one recorded archeological site (E469) mapped on Plan 32 of the Southland District Council Proposed District Plan. This is 1200m west of the dairy platform boundary.

There is no indigenous vegetation on the property. There are no outstanding natural features or landscapes or visual amenity landscapes within the farm or on neigbouring farms.

4. Nutrient Budget

5. Good Management Practices

6. Riparian Management Plan

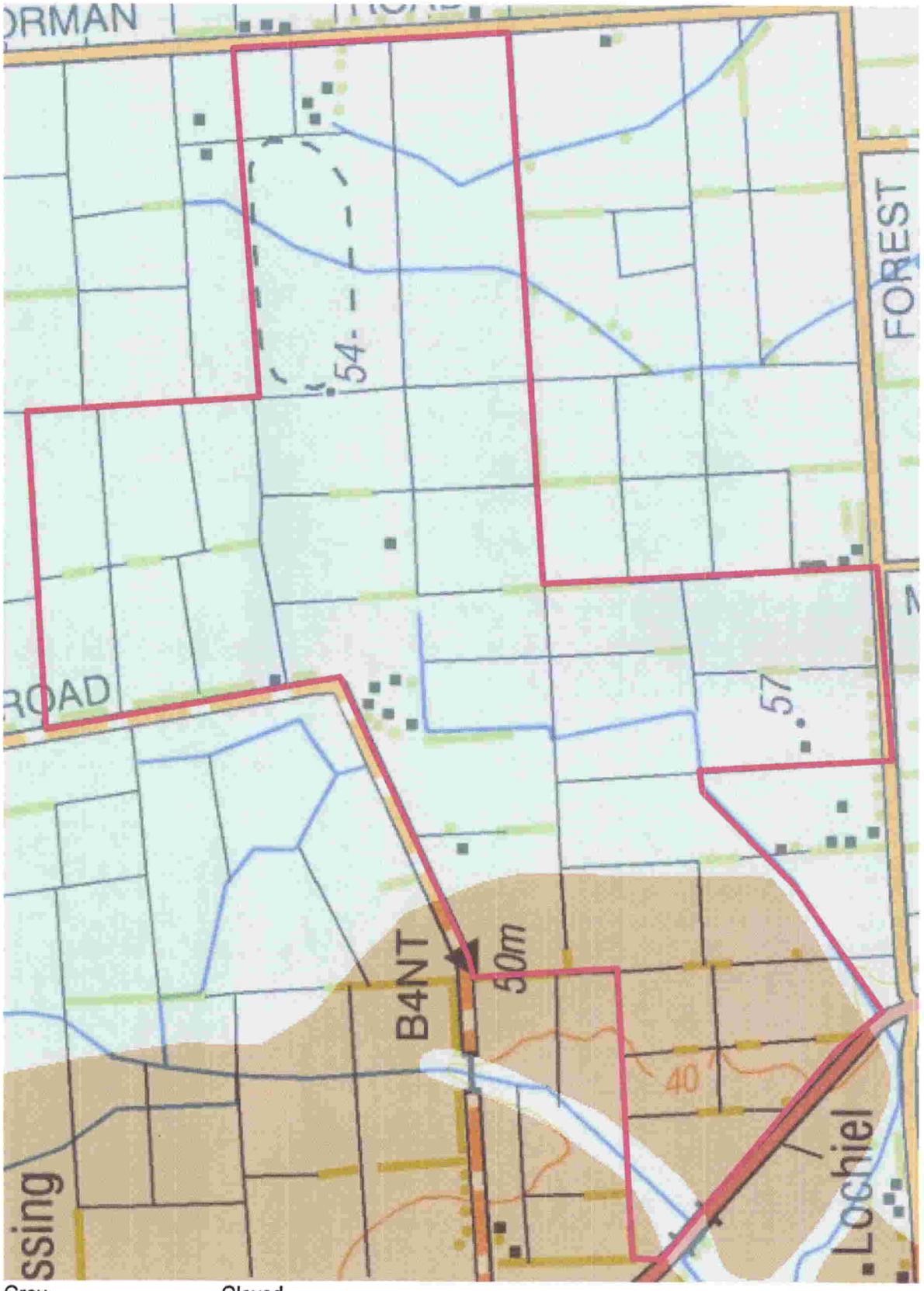
7. Cultivation

8. Intensive Winter Grazing

9. Collected Agricultural Effluent

Effluent Management Plan

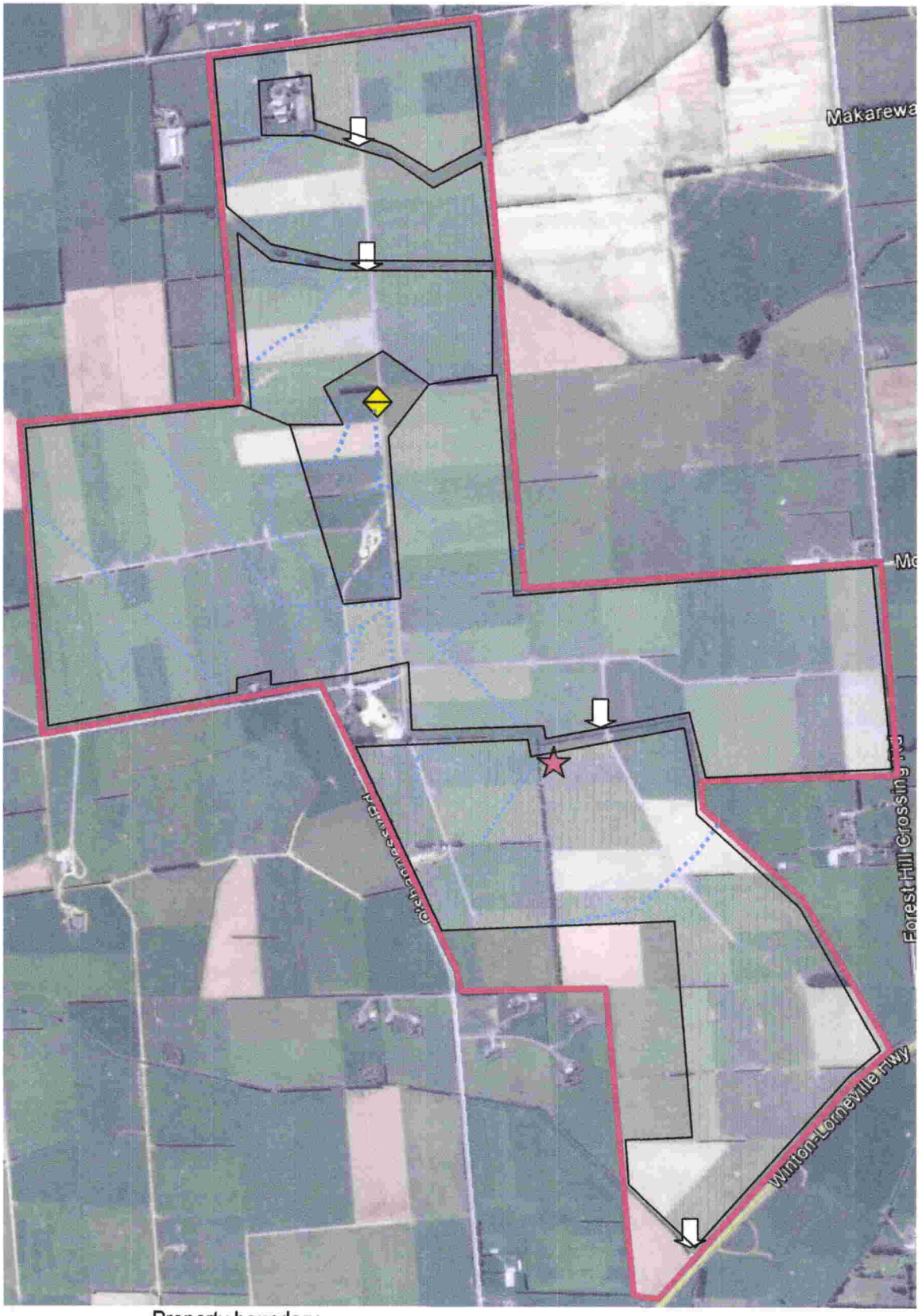
PHYSIOGRAPHIC MAP



Grey Brown

Gleyed Oxidising

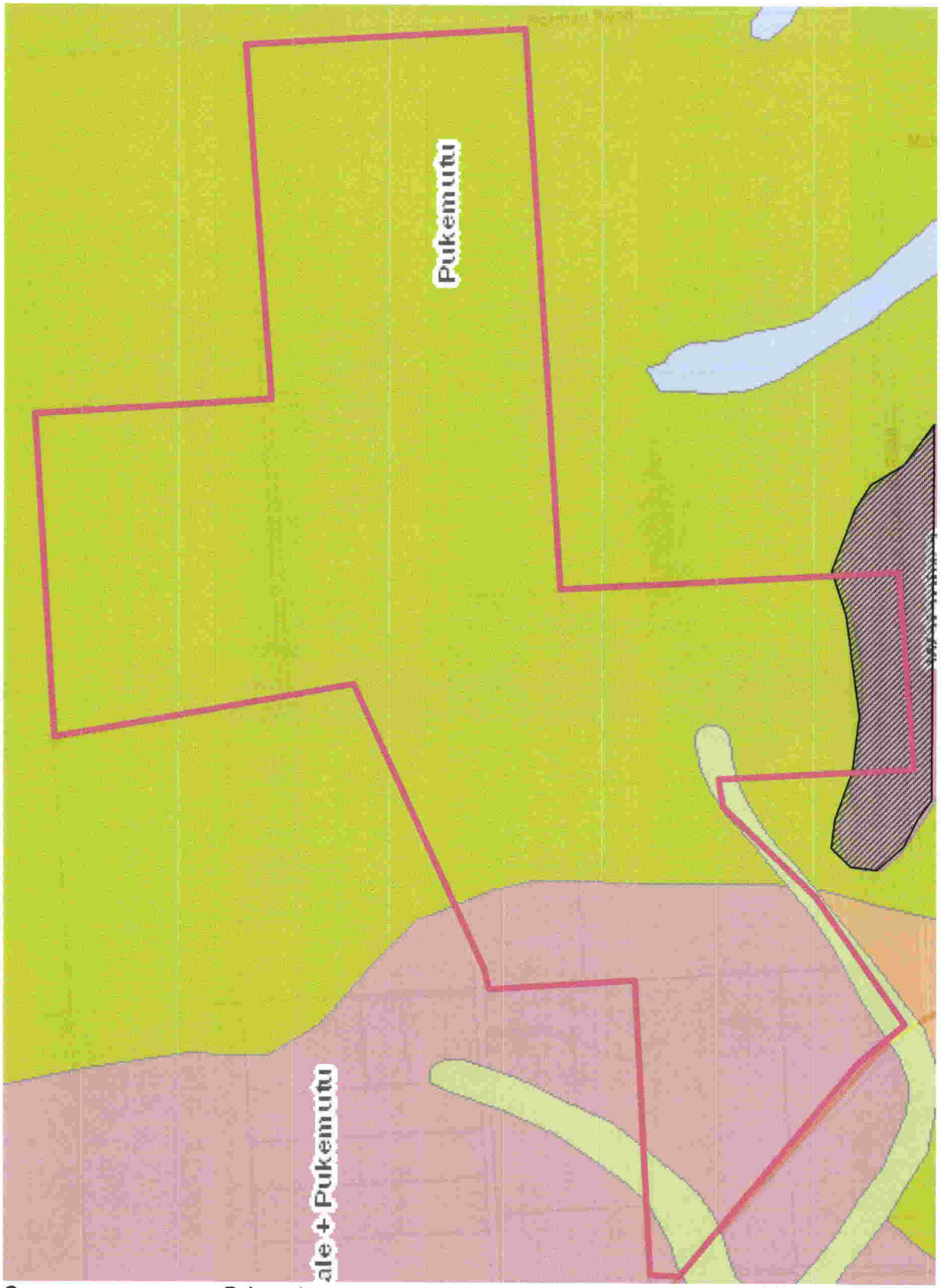
AERIAL MAP



Property boundary

Discharge area

SOIL MAP



Green	Pukemutu
Brown	Edendale
Brown hatched	Waianiwa
Light Green	Northope

4 NUTRIENT BUDGET

5 GOOD MANAGEMENT PRACTISES

Gleyed Physiographic Zone

Reducing the effects of artificial drainage by:

- Protecting soil structure, particularly in gullies and near stream areas.
- Reducing phosphorus use and loss.
- Reducing the accumulation of surplus nitrogen in the soil, particularly during autumn and winter.
- Avoiding preferential flow of effluent through drains.
- Capturing contaminants at drainage outflows.

Reducing the effects of overland flow:

- Protecting soil structure, particularly in gullies and near stream areas.
- Managing critical source areas.
- Reducing phosphorus use and loss.

The key transport pathways and contaminants for this physiographic zone is overland flow and artificial drainage

Oxidizing Physiographic Zone

Reducing the effects of artificial drainage by:

- Protecting soil structure, particularly in gullies and near stream areas.
- Reducing phosphorus use and loss.
- Reducing the accumulation of surplus nitrogen in the soil, particularly during autumn and winter.
- Avoiding preferential flow of effluent through drains.
- Capturing contaminants at drainage outflows.

Reducing the effects of overland flow:

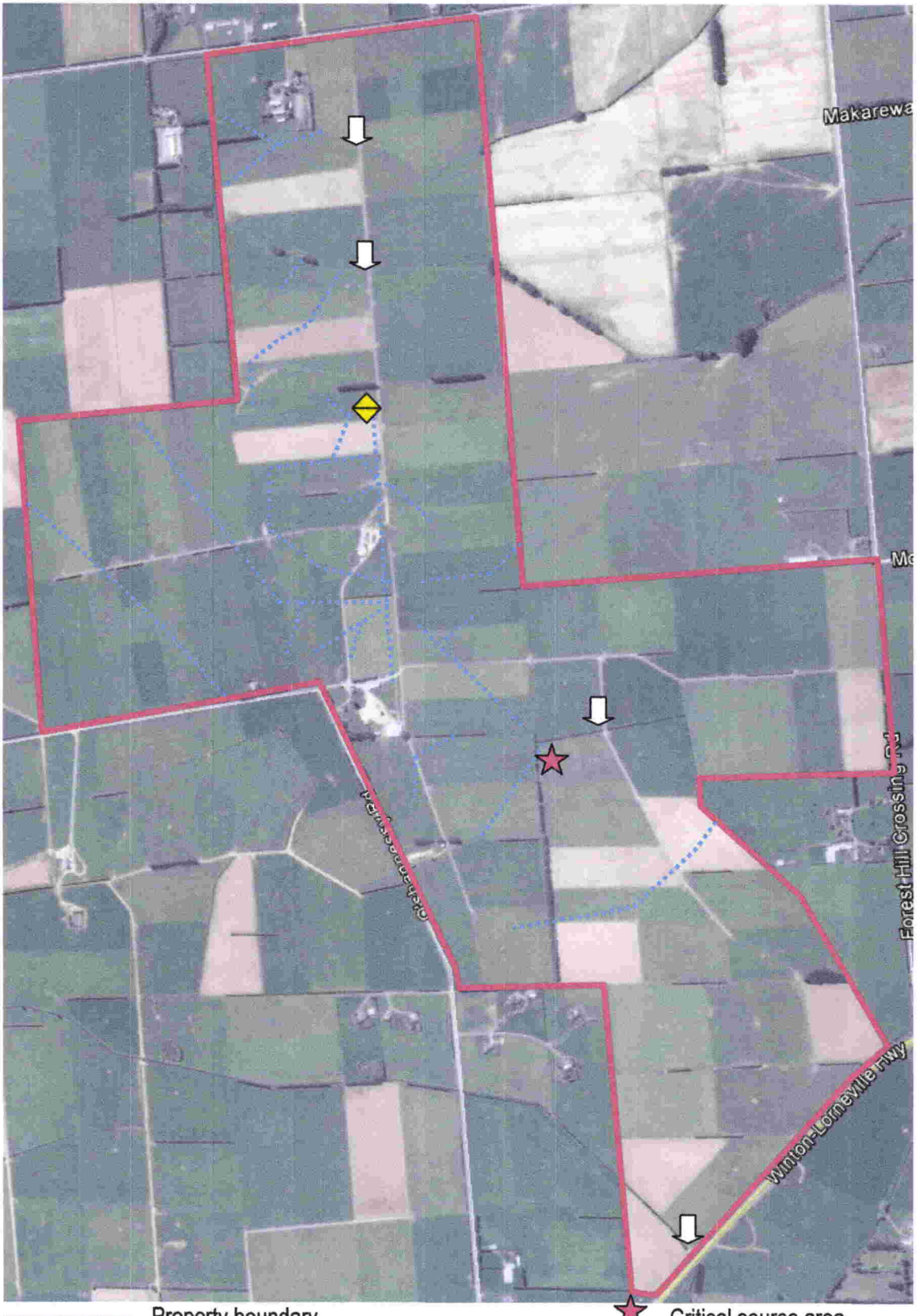
- Protecting soil structure, particularly in gullies and near stream areas.
- Managing critical source areas.
- Reducing phosphorus use and loss.

The key transport pathways and contaminants for this physiographic zone is overland flow and artificial drainage

The farm has 80% less than 7 degress and 20% greater than 7 degress. There will be significant artificial drainage on the farm. The farm has mostly 'high risk' soils so care with spreading depths is important. The farm has a Herd Home that will be used to keep stock off wet paddocks to protect soil structure.

Good Management Practices – 1 June 2016 to 31 May 2017

- Establish the new area into the dairy farm operating practices and effluent management systems.
- Identify tiles and mark the ends at entry to open drains.
- Identify additional critical source areas where storm water runs during heavy rain.
- Soil tests at least every second year and limited the use of fertilizer to bring the nutrient levels to optimum levels but not above agronomic optimum.
- The farm will check that the riparian strips are adequate.
- The Herd Home use will be monitored to mimimise pasture damage.


Makarewa
Forest Hill Crossing Rd
Winton-Lorneville Hwy
Property boundary
Discharge area
Open stream
Intermittent drain
Critical source area
Bridge or culvert
Bore
Tiles

- All open drains are fenced with two wire electric fences to exclude stock. All open drains have culverts for stock to cross.
- There are no sheep on the farm.
- Define the critical source areas and plan fencing of these.
- Riparian areas are well vegetated with pasture species and 50% planted. Noxious weeds will be controlled.
- There will be no grazing of riparian margins.
- The existing drains are no maintained by Environment Southland but can be accessed to clear if necessary

The plan for 1 June to 2016 to 31 May 2017

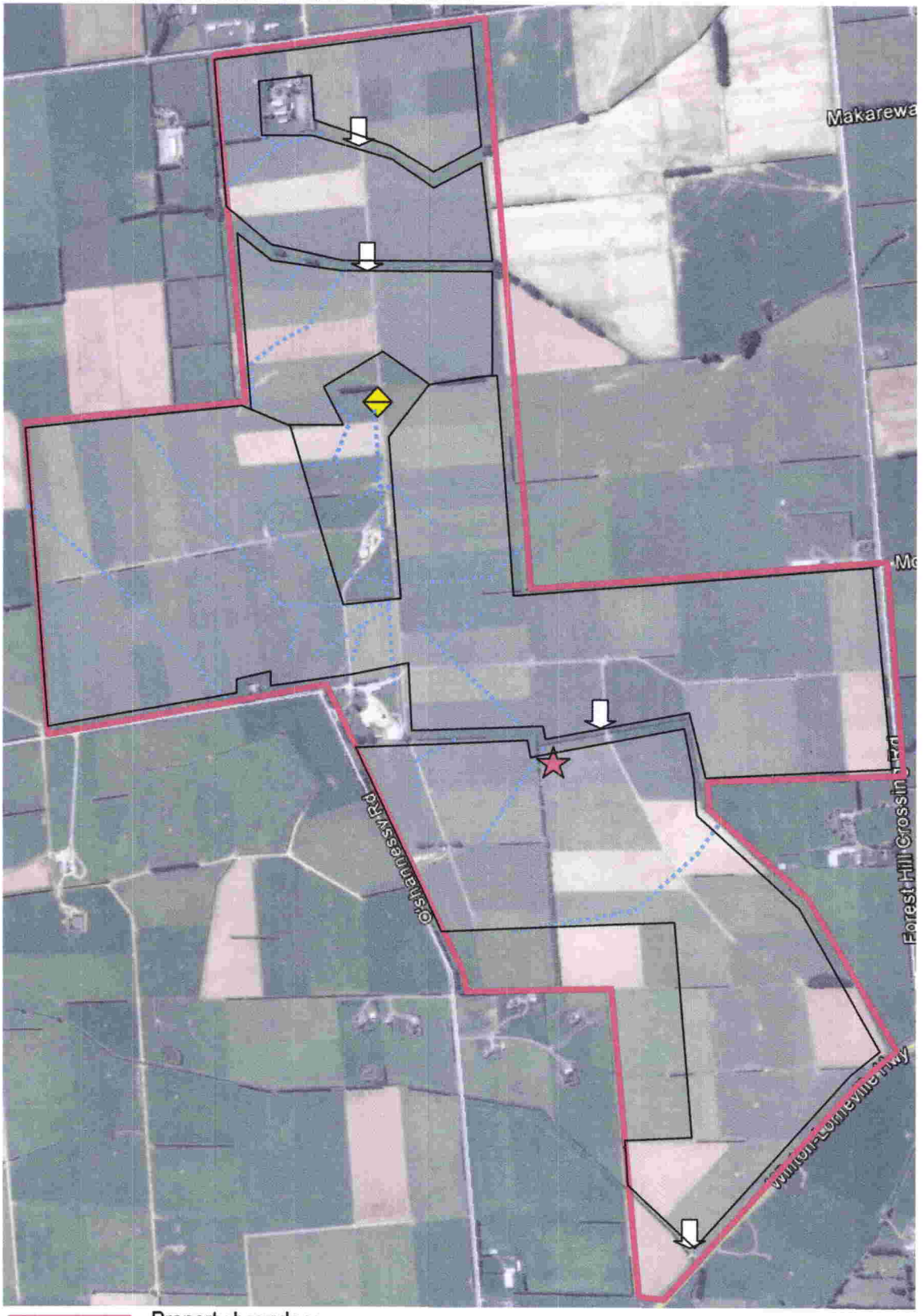
- Identify any tiles and outlets.
- Identify additional critical source areas where storm water runs in heavy rain.
- The farm will check that the riparian strips are adequate and that fences are the correct distance from waterways.
- Ensure all fences keep stock out of water.
- Fence known critical source areas temporarily initially to establish the optimum location for fences.

7 and 8 CULTIVATION and WINTER GRAZING

Up to 20 ha of fodder crops and 20ha of cultivation for re-grsssing.

1 June 2017to 31 May 2018

9 COLLECTED AGRICULTURAL EFFLUENT



Property boundary
Discharge area
Open drains

This map is to be marked up each time effluent is applied. For each effluent application record the date, depth and application rate.

Also refer to the Collect Agricultural Effluent Management Plan and Appendix 1 to confirm all separation distances to drains boundaries and bores.

Nutrient Budget

NB 2016 -17 Current DSN 31827 {Copy}

for SOUTH DAIRY LTD

Prepared by Farm Environmental Consultant

Mark Crawford

16/01/2017

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Parameters

Farm details		
Type	Farm type	Full range
Assessment	Assessment year	2016
Region	Region	Southland
Farm blocks		
Puke_6a.1 Effluent Tile	Pastoral	54.5
Puke_6a.1 Non Eff Lease	Pastoral	39.5
Puke_6a.1 Non Eff Tile	Pastoral	48.6
Puke_6a.1 Non Effluent	Pastoral	49.7
Riparian Areas	Riparian	1.2
Waiki_30a.1 Non Eff	Pastoral	17.9
Waiki_30a.1 Run Off	Pastoral	23.7
Parah_4a.1 Non Effluent	Pastoral	2.7
Parah_4a.1 Run Off	Pastoral	2.9
Apar_2a.1 Non Eff Lease	Pastoral	4.5
Total farm area declared in blocks	ha	245.2
Total farm area	ha	249.2
Non-productive area	ha	4
Farm animals		
Stock numbers		
Stock reconciliation - Dairy		
Production		
Milk solids	kg/yr	272600
Milk volume yield	l/yr	Not entered
Fat yield	kg/yr	Not entered
Lactation length	days	Not entered
Average weight	kg/animal	Not entered
Calving times		
Default calving times used		
Stock numbers		
Mob Name		MilkingHerd
Class		MilkingHerd
Breed		F x J cross
Data input		Using grid

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January	575
February	575
March	575
April	550
May	500
August	406
September	600
October	595
November	580
December	580
Max weight(kg)	520
Live weight start (kg)	Use default
Live weight end (kg)	Use default
Carcass weight (kg)	Use default
Age start (months))	Use default
Source	Use default
Fate	Use default
Sex	Female
Mated	Use default
Stock numbers	
Mob Name	HeiferReplacements
Class	HeiferReplacements
Breed	F x J cross
Data input	Using grid
January	130
February	130
March	130
April	130
May	130
November	130
December	130
Max weight(kg)	Use default
Live weight start (kg)	Use default
Live weight end (kg)	230
Carcass weight (kg)	Use default
Age start (months))	Use default
Source	WeanedFromFarm
Fate	Use default

Sex		Female
Mated		Use default
Mob Name		HeiferReplacements
Class		HeiferReplacements
Breed		F x J cross
Data input		Using grid
July		32
Max weight(kg)		Use default
Live weight start (kg)		480
Live weight end (kg)		480
Carcass weight (kg)		Use default
Age start (months))		Use default
Source		Purchased
Fate		Use default
Sex		Female
Mated		Use default

Stock management

Animal excreta distribution

Relative productivity assessment method	No difference between blocks
All blocks have a relative productivity value of 1	
Ratio of stock on blocks can differ from the farm stock ratios	

Farm dairy effluent disposal system

Effluent disposal method	Spray from sump

Animal health supplements

Animal - Dairy

No animal supplementation has been entered

Animal - Dairy

No animal supplementation has been entered

Left over feeding

No left over feeding specified

No supplements from storage added to this farm

Imported supplements

Supplement information		
Conservation type		Silage
Name		Pasture good quality silage
Pasture type		
Supplement amount		
Dry weight basis	T	25

Fed on blocks: Puke_6a.1 Effluent TilePuke_6a.1 Non Eff LeasePuke_6a.1 Non Eff TilePuke_6a.1 Non EffluentWaiki_30a.1 Nc		
Supplement information		
Conservation type		Process byproducts
Name		Palm kernel meal
Pasture type		
Supplement amount		
Dry weight basis	T	90
Fed on blocks: Puke_6a.1 Effluent TilePuke_6a.1 Non Eff LeasePuke_6a.1 Non Eff TilePuke_6a.1 Non EffluentWaiki_30a.1 Nc		
Greenhouse Gas Footprint		
Greenhouse gas emission factors		
Enteric methane - g methane/kg DMI intake		
Dairy		21.6
Dairy replacements		21.6
Sheep		20.9
Beef		21.6
Deer		21.3
Goats		20.9
Camelids		20.9
Young sheep		16.8
Horses	kg Methane/RSU	1.8
User defined	kg Methane/RSU	1.5
Dung methane - g methane/kg dung		
Dairy		0.982
Dairy replacements		0.982
Sheep		0.691
Beef		0.982
Deer		0.915
Goats		0.691
Other		0.691
Nitrous oxide		
Use farm specific emission factors		
Fuel and electricity		
Embodied CO2 emissions		
Diesel	kg CO2 equivalents/l	2.989
Petrol	kg CO2 equivalents/l	2.773
Electricity	kg CO2 equivalents/k	0.271
Energy emissions		
Diesel	MJ / litre	42.24

Petrol	MJ / litre	42.4
Electricity	MJ / kWh	8.21
GWP		
Use NZ national inventory		
Allocation		
Allocation method		Enter actual allocation figures

Report settings

Greenhouse gas emission report units CO2 equivalents (kg/ha)

Target N application rate as effluent 150 kg N/ha/yr

Fertiliser costs $/kg nutrient

N	P	K	S	Ca	Na	Mg
1.45	3.5	2.4	0.35	0.2	0.8	1.4

Block Information

Block - Puke_6a.1 Effluent Tile

Block name		Puke_6a.1 Effluent Tile
Block type		Pastoral
Area	ha	54.5
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False

Climate

Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default

Soil description

Soil order (default)		Pallic
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Pukem_6a.1
Wilting point	0 - 30cm	22
	30 - 60cm	25
	> 60	1
Field Capacity	0 - 30cm	40
	30 - 60cm	41
	> 60	2

Saturation	0 - 30cm	54
	30 - 60cm	48
	> 60	3
Natural drainage class		Poor
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.58
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		22
Sand	%	9
Bulk density	kg/m^3	1220
Clay	%	27
Sub soil clay	%	29
Soil profile		
Profile drainage class	Use default	Use default
Stony top soil		False
Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.58
Maximum rooting depth		0.58
Soil drainage		
Drainage Method		
Method		Mole/tile system
Percent of paddock drained		100
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		
N immobilisation status		

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
38.2	9.6	10.0	28.6	9.6

Organic S	15

Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		750
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		40
Fertiliser products - September		
Category		User defined
Product		UREA BULK
Amount		60
Fertiliser products - February		

Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - December		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - March		
Category		Ravensdown other
Product		Urea
Amount		60
Fertiliser products - April		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - May		
Category		Ravensdown other
Product		Urea
Amount		20
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Animal grazing		
Dairy	%	100
January		True
February		True
March		True
April		True
May		True
August		True
September		True
October		True
November		True
December		True
Water connectivity		
Direct access to streams		
Effluent Application		

Liquid effluents		
Receives farm dairy effluent		
Effluent application depth	Low application meth	
Percentage of block effluent applied to	%	0
Block - Puke_6a.1 Non Eff Lease		
Block name		Puke_6a.1 Non Eff Lease
Block type		Pastoral
Area	ha	39.5
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Pallic
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Pukem_6a.1
Wilting point	0 - 30cm	22
	30 - 60cm	25
	> 60	1
Field Capacity	0 - 30cm	40
	30 - 60cm	41
	> 60	2
Saturation	0 - 30cm	54
	30 - 60cm	48
	> 60	3
Natural drainage class		Poor
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.58
Depth to impeded layer	cm	0
Soil texture group		

Non-standard layer		
Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		22
Sand	%	9
Bulk density	kg/m³	1220
Clay	%	27
Sub soil clay	%	29
Soil profile		
Profile drainage class	Use default	Use default
Stony top soil		False
Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.58
Maximum rooting depth		0.58
Soil drainage		
Drainage Method		
Method		None
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		
N immobilisation status		

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30.0	7.0	10.0	20.0	9.0

QT SO4		5
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered

Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		1000
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		40
Fertiliser products - September		
Category		User defined
Product		UREA BULK
Amount		60
Fertiliser products - February		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - December		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - March		
Category		Ravensdown other
Product		Urea

Amount		60
Fertiliser products - April		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - May		
Category		Ravensdown other
Product		Urea
Amount		20
Fertiliser products - January		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - November		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - December		
Category		Ravensdown other
Product		Potassium chloride
Amount		50
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Animal grazing		
Dairy	%	100
January		True
February		True
March		True
April		True
May		True
August		True
September		True
October		True
November		True
December		True
Water connectivity		

Direct access to streams		
Effluent Application		
Receives no liquid or solid effluents		
Block - Puke_6a.1 Non Eff Tile		
Block name		Puke_6a.1 Non Eff Tile
Block type		Pastoral
Area	ha	48.6
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Pallic
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Pukem_6a.1
Wilting point	0 - 30cm	22
	30 - 60cm	25
	> 60	1
Field Capacity	0 - 30cm	40
	30 - 60cm	41
	> 60	2
Saturation	0 - 30cm	54
	30 - 60cm	48
	> 60	3
Natural drainage class		Poor
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.58
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		

Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		22
Sand	%	9
Bulk density	kg/m³	1220
Clay	%	27
Sub soil clay	%	29
Soil profile		
Profile drainage class	Use default	Use default
Stony top soil		False
Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.58
Maximum rooting depth		0.58
Soil drainage		
Drainage Method		
Method		Mole/tile system
Percent of paddock drained		100
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		
N immobilisation status		

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
35.0	8.0	10.0	22.0	8.0

QT SO4		5
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered

Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		750
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		40
Fertiliser products - September		
Category		User defined
Product		UREA BULK
Amount		60
Fertiliser products - February		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - December		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - March		
Category		Ravensdown other
Product		Urea

Amount		60
Fertiliser products - April		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - May		
Category		Ravensdown other
Product		Urea
Amount		20
Fertiliser products - January		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - November		
Category		Ravensdown other
Product		Urea
Amount		40
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Animal grazing		
Dairy	%	100
January		True
February		True
March		True
April		True
May		True
August		True
September		True
October		True
November		True
December		True
Water connectivity		
Direct access to streams		
Effluent Application		
Receives no liquid or solid effluents		
Block - Puke_6a.1 Non Effluent		

Block name		Puke_6a.1 Non Effluent
Block type		Pastoral
Area	ha	49.7
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Pallic
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Pukem_6a.1
Wilting point	0 - 30cm	22
	30 - 60cm	25
	> 60	1
Field Capacity	0 - 30cm	40
	30 - 60cm	41
	> 60	2
Saturation	0 - 30cm	54
	30 - 60cm	48
	> 60	3
Natural drainage class		Poor
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.58
Depth to impeded layer	cm	58
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		22
Sand	%	9

Bulk density	kg/m³	1220
Clay	%	28
Sub soil clay	%	29
Soil profile		
Profile drainage class		Use default
Stony top soil		False
Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.00
Maximum rooting depth		0.58
Soil drainage		
Drainage Method		
Method		None
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		
N immobilisation status		

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
35.0	8.0	10.0	22.0	8.0

QT SO4		5
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover

Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		750
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		40
Fertiliser products - September		
Category		User defined
Product		UREA BULK
Amount		60
Fertiliser products - February		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - December		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - March		
Category		Ravensdown other
Product		Urea
Amount		60
Fertiliser products - April		
Category		Ravensdown other
Product		Urea
Amount		40

Fertiliser products - May		
Category		Ravensdown other
Product		Urea
Amount		20
Fertiliser products - January		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - November		
Category		Ravensdown other
Product		Urea
Amount		40
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Animal grazing		
Dairy	%	100
January		True
February		True
March		True
April		True
May		True
August		True
September		True
October		True
November		True
December		True
Water connectivity		
Direct access to streams		
Effluent Application		
Receives no liquid or solid effluents		
Block - Riparian Areas		
Block name		Riparian Areas
Block type		Riparian
Area	ha	1.2
Block - Waiki_30a.1 Non Eff		
Block name		Waiki_30a.1 Non Eff

Block type		Pastoral
Area	ha	17.9
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Brown
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Waiki_30a.1
Wilting point	0 - 30cm	21
	30 - 60cm	23
	> 60	25
Field Capacity	0 - 30cm	42
	30 - 60cm	41
	> 60	43
Saturation	0 - 30cm	59
	30 - 60cm	52
	> 60	49
Natural drainage class		Well
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.00
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		43
Sand	%	4
Bulk density	kg/m^3	1090

Clay	%	28
Sub soil clay	%	28
Soil profile		
Profile drainage class		Use default
Stony top soil		False
Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.00
Maximum rooting depth		0.00
Soil drainage		
Drainage Method		
Method		None
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		
N immobilisation status		
Soil tests		

Olsen P	QT K	QT Ca	QT Mg	QT Na
30.0	7.0	10.0	20.0	9.0

QT SO4		5
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Advanced soil settings		
Organic matter status		
Bulk density	kg/m^3	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		

Pasture utilisation	%	0
Average annual pasture N content	%	0

Supplements removed

No supplements removed from this block

Fertiliser application

Fertiliser products - December

Category	User defined
Product	2/3 Super & Lime
Amount	750

Fertiliser products - August

Category	Ravensdown cropping
Product	Ammo 36
Amount	100

Fertiliser products - October

Category	User defined
Product	Eff - Urea + Se
Amount	40

Fertiliser products - September

Category	User defined
Product	UREA BULK
Amount	60

Fertiliser products - February

Category	User defined
Product	UREA BULK
Amount	40

Fertiliser products - December

Category	User defined
Product	UREA BULK
Amount	40

Fertiliser products - March

Category	Ravensdown other
Product	Urea
Amount	60

Fertiliser products - April

Category	Ravensdown other
Product	Urea
Amount	40

Fertiliser products - May

Category		Ravensdown other
Product		Urea
Amount		20
Fertiliser products - January		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - November		
Category		Ravensdown other
Product		Urea
Amount		40
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Animal grazing		
Dairy	%	100
January		True
February		True
March		True
April		True
May		True
August		True
September		True
October		True
November		True
December		True
Water connectivity		
Direct access to streams		
Effluent Application		
Receives no liquid or solid effluents		
Block - Waiki_30a.1 Run Off		
Block name		Waiki_30a.1 Run Off
Block type		Pastoral
Area	ha	23.7
Relative productivity		1
Fodder crop rotation		No
Topography		Flat

Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Brown
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Waiki_30a.1
Wilting point	0 - 30cm	21
	30 - 60cm	23
	> 60	25
Field Capacity	0 - 30cm	42
	30 - 60cm	41
	> 60	43
Saturation	0 - 30cm	59
	30 - 60cm	52
	> 60	49
Natural drainage class		Well
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.00
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		43
Sand	%	4
Bulk density	kg/m^3	1090
Clay	%	28
Sub soil clay	%	28
Soil profile		
Profile drainage class		Use default
Stony top soil		False

Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.00
Maximum rooting depth		0.00
Soil drainage		
Drainage Method		
Method		None
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		
N immobilisation status		
Soil tests		

Olsen P	QT K	QT Ca	QT Mg	QT Na
27.0	9.0	9.0	16.0	10.0

QT SO4		10
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Advanced soil settings		
Organic matter status		
Bulk density	kg/m^3	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplement removed		
Supplement information		
Conservation type		Baleage

Name		
Pasture type		
Wrapping	Wrapped in plastic	
Supplement amount		
Number of bales		350
Packaging		Round bales
Bale size		
Standard bale equivalents		12
Fed to animal: Dairy		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		750
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		40
Fertiliser products - September		
Category		User defined
Product		UREA BULK
Amount		60
Fertiliser products - February		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - December		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - March		
Category		Ravensdown other
Product		Urea
Amount		60

Fertiliser products - April		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - May		
Category		Ravensdown other
Product		Urea
Amount		20
Fertiliser products - January		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - November		
Category		Ravensdown other
Product		Urea
Amount		40
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Animal grazing		
Dairy	%	60
January		True
February		True
March		True
April		True
May		True
August		True
September		True
October		True
Water connectivity		
Direct access to streams		
Animal grazing		
DairyReplacement	%	40
January		True
February		True
March		True
April		True

May		True
July		True
November		True
December		True
Water connectivity		
Direct access to streams		
Effluent Application		
Receives no liquid or solid effluents		
Block - Parah_4a.1 Non Effluent		
Block name		Parah_4a.1 Non Effluent
Block type		Pastoral
Area	ha	2.7
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Pallic
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Parah_4a.1
Wilting point	0 - 30cm	24
	30 - 60cm	26
	> 60	27
Field Capacity	0 - 30cm	38
	30 - 60cm	38
	> 60	39
Saturation	0 - 30cm	50
	30 - 60cm	46
	> 60	44
Natural drainage class		Imperfect
Top soil texture		Unknown

Is Stony		False
Maximum rooting depth	cm	0.00
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	

Top soil horizon chemical and physical parameters

ASC/PR		23
Sand	%	12
Bulk density	kg/m³	1220
Clay	%	34
Sub soil clay	%	34

Soil profile

Profile drainage class	Use default
Stony top soil	False
Sub-soil textural group	
Depth to non-standard layer	0.00
Depth to impeded drainage layer	0.00
Maximum rooting depth	0.00

Soil drainage

Drainage Method	
Method	None
Hydrophobic condition	Use default
Occurence of pugging damage	Occasional
Compacted top soil	False

Soil settings

K leaching potential not set

N immobilisation status

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30.0	7.0	10.0	20.0	9.0

QT SO4	5
Anion storage capacity or phosphate retention	Not entered
TBK reserve K test	Not entered
K reserve status	Use default

Advanced soil settings

Organic matter status		
Bulk density	kg/m³	0

Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		750
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		40
Fertiliser products - September		
Category		User defined
Product		UREA BULK
Amount		60
Fertiliser products - February		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - December		
Category		User defined
Product		UREA BULK

Amount		40
Fertiliser products - March		
Category		Ravensdown other
Product		Urea
Amount		60
Fertiliser products - April		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - May		
Category		Ravensdown other
Product		Urea
Amount		20
Fertiliser products - January		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - November		
Category		Ravensdown other
Product		Urea
Amount		40
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Animal grazing		
Dairy	%	100
January		True
February		True
March		True
April		True
May		True
August		True
September		True
October		True
November		True
December		True
Water connectivity		

Direct access to streams		
Effluent Application		
Receives no liquid or solid effluents		
Block - Parah_4a.1 Run Off		
Block name		Parah_4a.1 Run Off
Block type		Pastoral
Area	ha	2.9
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Pallic
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Parah_4a.1
Wilting point	0 - 30cm	24
	30 - 60cm	26
	> 60	27
Field Capacity	0 - 30cm	38
	30 - 60cm	38
	> 60	39
Saturation	0 - 30cm	50
	30 - 60cm	46
	> 60	44
Natural drainage class		Imperfect
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.00
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		

Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		23
Sand	%	12
Bulk density	kg/m³	1220
Clay	%	34
Sub soil clay	%	34
Soil profile		
Profile drainage class		Use default
Stony top soil		False
Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.00
Maximum rooting depth		0.00
Soil drainage		
Drainage Method		
Method		None
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		
N immobilisation status		

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
27.0	8.7	8.9	16.0	10.2

Organic S		10.5
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered

Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplement removed		
Supplement information		
Conservation type		Baleage
Name		
Pasture type		
Wrapping	Wrapped in plastic	
Supplement amount		
Number of bales		50
Packaging		Round bales
Bale size		
Standard bale equivalents		12
Fed to animal: Dairy		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		750
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		40
Fertiliser products - September		
Category		User defined
Product		UREA BULK
Amount		60
Fertiliser products - February		
Category		User defined

Product		UREA BULK
Amount		40
Fertiliser products - December		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - March		
Category		Ravensdown other
Product		Urea
Amount		60
Fertiliser products - April		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - May		
Category		Ravensdown other
Product		Urea
Amount		20
Fertiliser products - January		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - November		
Category		Ravensdown other
Product		Urea
Amount		40
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Animal grazing		
Dairy	%	60
January		True
February		True
March		True
April		True
May		True
August		True

September		True
October		True
Water connectivity		
Direct access to streams		
Animal grazing		
DairyReplacement	%	40
January		True
February		True
March		True
April		True
May		True
July		True
November		True
December		True
Water connectivity		
Direct access to streams		
Effluent Application		
Receives no liquid or solid effluents		
Block - Apar_2a.1 Non Eff Lease		
Block name		Apar_2a.1 Non Eff Lease
Block type		Pastoral
Area	ha	4.5
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Brown
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Apar_2a.1
Wilting point	0 - 30cm	23

	30 - 60cm	26
	> 60	1
Field Capacity	0 - 30cm	45
	30 - 60cm	42
	> 60	2
Saturation	0 - 30cm	63
	30 - 60cm	53
	> 60	3
Natural drainage class		Imperfect
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.58
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		43
Sand	%	6
Bulk density	kg/m^3	1090
Clay	%	25
Sub soil clay	%	28
Soil profile		
Profile drainage class		Use default
Stony top soil		False
Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.00
Maximum rooting depth		0.58
Soil drainage		
Drainage Method		
Method		None
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		
N immobilisation status		

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30.0	7.0	10.0	20.0	9.0

QT SO4		5
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		750
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		40
Fertiliser products - September		

Category		User defined
Product		UREA BULK
Amount		60
Fertiliser products - February		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - December		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - March		
Category		Ravensdown other
Product		Urea
Amount		60
Fertiliser products - April		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - May		
Category		Ravensdown other
Product		Urea
Amount		20
Fertiliser products - January		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - November		
Category		Ravensdown other
Product		Urea
Amount		40
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Animal grazing		
Dairy	%	100
January		True

February	True
March	True
April	True
May	True
August	True
September	True
October	True
November	True
December	True

Water connectivity

Direct access to streams

Effluent Application

Receives no liquid or solid effluents

Nutrient Budget

NB 2016 -17 Consent DSN 31827 {Copy}

for SOUTH DAIRY LTD

Prepared by Farm Environmental Consultant

Mark Crawford

16/01/2017

OVERSEER

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Parameters

OVERSEER

Farm details		
Type	Farm type	Full range
Assessment	Assessment year	2016
Region	Region	Southland
Farm blocks		
Puke_6a.1 Effluent	Pastoral	12.9
Puke_6a.1 Effluent Tile	Pastoral	65.9
Puke_6a.1 Effluent Solid Lease	Pastoral	39.5
Puke_6a.1 Effluent SolidTile	Pastoral	37.2
Puke_6a.1Effluent Solid	Pastoral	36.8
Riparian Areas	Riparian	1.2
Waiki_30a.1 Eff Solids	Pastoral	17.9
Waiki_30a.1 Run Off	Pastoral	23.7
Parah_4a.1 Eff solids	Pastoral	2.7
Parah_4a.1 Run Off	Pastoral	2.9
Apar_2a.1 Eff solids Lease	Pastoral	4.5
Total farm area declared in blocks	ha	245.2
Total farm area	ha	249.2
Non-productive area	ha	4
Farm animals		
Stock numbers		
Stock reconciliation - Dairy		
Production		
Milk solids	kg/yr	352000
Milk volume yield	l/yr	Not entered
Fat yield	kg/yr	Not entered
Lactation length	days	Not entered
Average weight	kg/animal	Not entered
Calving times		
Default calving times used		
Stock numbers		
Mob Name		MilkingHerd
Class		MilkingHerd
Breed		F x J cross

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Data input		Using grid
January		700
February		700
March		700
April		650
May		600
August		630
September		780
October		760
November		750
December		750
July		32
Max weight(kg)		500
Live weight start (kg)		Use default
Live weight end (kg)		Use default
Carcass weight (kg)		Use default
Age start (months))		Use default
Source		Use default
Fate		Use default
Sex		Female
Mated		Use default
Stock management		
Dairy - Wintering pad, animal shelter or housing		
Construction		
Pad type		Uncovered wintering pad
Pad surface		Carbon rich (sawdust; bark; woodchips)
Lined or subsurface drainage capture		True
Surface craped regularly		False
Liquid effluent management		
Added to farm dairy effluent		True
Solid effluent management		
Solid disposal method		Spread on selected blocks
Storage method		No Storage
Time spent on structure		
August	60	8
September	30	8
May	30	8
July	100	20

Animal excreta distribution		
Relative productivity assessment method		No difference between blocks
All blocks have a relative productivity value of 1		
Ratio of stock on blocks can differ from the farm stock ratios		
Farm dairy effluent disposal system		
Effluent disposal method		Holding pond
Pond sludge disposal method		Spread on selected blocks
Solid separation and disposal		True
Liquid disposal method		Spray infrequently
Animal health supplements		
Animal - Dairy		
No animal supplementation has been entered		
Animal - Dairy Replacement		
No animal supplementation has been entered		
Left over feeding		
No left over feeding specified		
Stored supplements		
Supplement information		
Conservation type		Baleage
Name		
Pasture type		
Supplement amount		
Dry weight basis	T	80
Fed to animal: Dairy		
Imported supplements		
Supplement information		
Conservation type		Silage
Name		Pasture good quality silage
Pasture type		
Supplement amount		
Dry weight basis	T	250
Fed on blocks: Puke_6a.1 EffluentPuke_6a.1 Effluent TilePuke_6a.1 Effluent Solid LeasePuke_6a.1 Effluent SolidTilePuke_6a		
Supplement information		
Conservation type		Process byproducts
Name		Palm kernel meal
Pasture type		
Supplement amount		
Dry weight basis	T	150

Fed on blocks: Puke_6a.1 EffluentPuke_6a.1 Effluent TilePuke_6a.1 Effluent Solid LeasePuke_6a.1 Effluent SolidTilePuke_6a		
Supplement information		
Conservation type		Silage
Name		Pasture good quality silage
Pasture type		
Supplement amount		
Dry weight basis	T	200
Utilisation		Very good
Destination		Dairy - Wintering pad, animal shelter or housing
Animal		Dairy
Greenhouse Gas Footprint		
Greenhouse gas emission factors		
Enteric methane - g methane/kg DMI intake		
Dairy		21.6
Dairy replacements		21.6
Sheep		20.9
Beef		21.6
Deer		21.3
Goats		20.9
Camelids		20.9
Young sheep		16.8
Horses	kg Methane/RSU	1.8
User defined	kg Methane/RSU	1.5
Dung methane - g methane/kg dung		
Dairy		0.982
Dairy replacements		0.982
Sheep		0.691
Beef		0.982
Deer		0.915
Goats		0.691
Other		0.691
Nitrous oxide		
Use farm specific emission factors		
Fuel and electricity		
Embodied CO2 emissions		
Diesel	kg CO2 equivalents/l	2.989
Petrol	kg CO2 equivalents/l	2.773
Electricity	kg CO2 equivalents/k	0.271

Energy emissions		
Diesel	MJ / litre	42.24
Petrol	MJ / litre	42.4
Electricity	MJ / kWh	8.21
GWP		
Use NZ national inventory		
Allocation		
Allocation method		Enter actual allocation figures

Report settings

Greenhouse gas emission report units CO2 equivalents (kg/ha)

Target N application rate as effluent 150 kg N/ha/yr

Fertiliser costs $/kg nutrient

N	P	K	S	Ca	Na	Mg
1.45	3.5	2.4	0.35	0.2	0.8	1.4

Block Information

Block - Puke_6a.1 Effluent

Block name		Puke_6a.1 Effluent
Block type		Pastoral
Area	ha	12.9
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Pallic
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Pukem_6a.1
Wilting point	0 - 30cm	22
	30 - 60cm	25
	> 60	1
Field Capacity	0 - 30cm	40

	30 - 60cm	41
	> 60	2
Saturation	0 - 30cm	54
	30 - 60cm	48
	> 60	3
Natural drainage class		Poor
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.58
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		22
Sand	%	9
Bulk density	kg/m³	1220
Clay	%	27
Sub soil clay	%	29
Soil profile		
Profile drainage class	Use default	Use default
Stony top soil		False
Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.58
Maximum rooting depth		0.58
Soil drainage		
Drainage Method		
Method		None
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		
N immobilisation status		

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
38.2	9.6	10.0	28.6	9.6

Organic S		15
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplement removed		
Supplement information		
Conservation type		Baleage
Name		
Pasture type		
Wrapping	Wrapped in plastic	
Supplement amount		
Dry weight basis	T	12
Destination		Storage
Storage conditions		Average
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		750
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100

Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		61
Fertiliser products - September		
Category		User defined
Product		UREA BULK
Amount		70
Fertiliser products - February		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - December		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - March		
Category		Ravensdown other
Product		Urea
Amount		60
Fertiliser products - April		
Category		Ravensdown other
Product		Urea
Amount		50
Fertiliser products - May		
Category		Ravensdown other
Product		Urea
Amount		20
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Ratio and type of stock based on whole farm values due to there being only one enterprise on the farm		
Animal grazing		
Dairy	%	0
January		True
February		True
March		True

April		True
May		True
August		True
September		True
October		True
November		True
December		True
Water connectivity		
Direct access to streams		
Effluent Application		
Liquid effluents		
Receives farm dairy effluent		
Effluent application depth	Low application meth	
Percentage of block effluent applied to	%	0
Block - Puke_6a.1 Effluent Tile		
Block name		Puke_6a.1 Effluent Tile
Block type		Pastoral
Area	ha	65.9
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Pallic
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Pukem_6a.1
Wilting point	0 - 30cm	22
	30 - 60cm	25
	> 60	1
Field Capacity	0 - 30cm	40
	30 - 60cm	41

	> 60	2
Saturation	0 - 30cm	54
	30 - 60cm	48
	> 60	3
Natural drainage class		Poor
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.58
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		22
Sand	%	9
Bulk density	kg/m³	1220
Clay	%	27
Sub soil clay	%	29
Soil profile		
Profile drainage class	Use default	Use default
Stony top soil		False
Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.58
Maximum rooting depth		0.58
Soil drainage		
Drainage Method		
Method		Mole/tile system
Percent of paddock drained		100
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		
N immobilisation status		

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
38.2	9.6	10.0	28.6	9.6

Organic S		15
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplement removed		
Supplement information		
Conservation type		Baleage
Name		
Pasture type		
Wrapping	Wrapped in plastic	
Supplement amount		
Dry weight basis	T	60
Destination		Storage
Storage conditions		Average
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		750
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100

Fertiliser products - October

Category	User defined
Product	Eff - Urea + Se
Amount	61

Fertiliser products - September

Category	User defined
Product	UREA BULK
Amount	70

Fertiliser products - February

Category	User defined
Product	UREA BULK
Amount	40

Fertiliser products - December

Category	User defined
Product	UREA BULK
Amount	40

Fertiliser products - March

Category	Ravensdown other
Product	Urea
Amount	60

Fertiliser products - April

Category	Ravensdown other
Product	Urea
Amount	50

Fertiliser products - May

Category	Ravensdown other
Product	Urea
Amount	20

Irrigation

Irrigation concentrations

Default concentrations used

Animals on block

Ratio and type of stock based on whole farm values due to there being only one enterprise on the farm

Animal grazing

Dairy	%	0
January		True
February		True
March		True

April		True
May		True
August		True
September		True
October		True
November		True
December		True
Water connectivity		
Direct access to streams		
Effluent Application		
Liquid effluents		
Receives farm dairy effluent		
Effluent application depth	Low application meth	
Percentage of block effluent applied to	%	0
Block - Puke_6a.1 Effluent Solid Lease		
Block name		Puke_6a.1 Effluent Solid Lease
Block type		Pastoral
Area	ha	39.5
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Pallic
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Pukem_6a.1
Wilting point	0 - 30cm	22
	30 - 60cm	25
	> 60	1
Field Capacity	0 - 30cm	40
	30 - 60cm	41

	> 60	2
Saturation	0 - 30cm	54
	30 - 60cm	48
	> 60	3
Natural drainage class		Poor
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.58
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		22
Sand	%	9
Bulk density	kg/m^3	1220
Clay	%	27
Sub soil clay	%	29
Soil profile		
Profile drainage class	Use default	Use default
Stony top soil		False
Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.58
Maximum rooting depth		0.58
Soil drainage		
Drainage Method		
Method		None
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		
N immobilisation status		
Soil tests		

Olsen P	QT K	QT Ca	QT Mg	QT Na
30.0	7.0	10.0	20.0	9.0

QT SO4	5

Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		1000
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		61
Fertiliser products - September		
Category		User defined
Product		UREA BULK
Amount		70
Fertiliser products - February		

Category		User defined
Product		UREA BULK
Amount		40

Fertiliser products - December

Category		User defined
Product		UREA BULK
Amount		40

Fertiliser products - March

Category		Ravensdown other
Product		Urea
Amount		60

Fertiliser products - April

Category		Ravensdown other
Product		Urea
Amount		50

Fertiliser products - May

Category		Ravensdown other
Product		Urea
Amount		20

Fertiliser products - January

Category		Ravensdown other
Product		Urea
Amount		60

Fertiliser products - November

Category		Ravensdown other
Product		Urea
Amount		40

Fertiliser products - December

Category		Ravensdown other
Product		Potassium chloride
Amount		50

Irrigation

Irrigation concentrations

Default concentrations used

Animals on block

Ratio and type of stock based on whole farm values due to there being only one enterprise on the farm

Animal grazing

Dairy	%	0

January		True
February		True
March		True
April		True
May		True
July		True
August		True
September		True
October		True
November		True
December		True
Water connectivity		
Direct access to streams		
Effluent Application		
Solid effluents		
Effluent type added	December	Pond solids/sludge *
Effluent type added	January	Holding pond separated solids
Effluent type added	November	Solids from wintering pad
Block - Puke_6a.1 Effluent SolidTile		
Block name		Puke_6a.1 Effluent SolidTile
Block type		Pastoral
Area	ha	37.2
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Pallic
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Pukem_6a.1
Wilting point	0 - 30cm	22

	30 - 60cm	25
	> 60	1
Field Capacity	0 - 30cm	40
	30 - 60cm	41
	> 60	2
Saturation	0 - 30cm	54
	30 - 60cm	48
	> 60	3
Natural drainage class		Poor
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.58
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		22
Sand	%	9
Bulk density	kg/m^3	1220
Clay	%	27
Sub soil clay	%	29
Soil profile		
Profile drainage class	Use default	Use default
Stony top soil		False
Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.58
Maximum rooting depth		0.58
Soil drainage		
Drainage Method		
Method		Mole/tile system
Percent of paddock drained		100
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		

N immobilisation status				
Soil tests				
Olsen P	QT K	QT Ca	QT Mg	QT Na
35.0	8.0	10.0	22.0	8.0

QT SO4		5
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		1000
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		61

Fertiliser products - September	
Category	User defined
Product	UREA BULK
Amount	70
Fertiliser products - February	
Category	User defined
Product	UREA BULK
Amount	40
Fertiliser products - December	
Category	User defined
Product	UREA BULK
Amount	40
Fertiliser products - March	
Category	Ravensdown other
Product	Urea
Amount	60
Fertiliser products - April	
Category	Ravensdown other
Product	Urea
Amount	50
Fertiliser products - May	
Category	Ravensdown other
Product	Urea
Amount	20
Fertiliser products - January	
Category	Ravensdown other
Product	Urea
Amount	60
Fertiliser products - November	
Category	Ravensdown other
Product	Urea
Amount	40
Fertiliser products - December	
Category	Ravensdown other
Product	Potassium chloride
Amount	50
Irrigation	
Irrigation concentrations	

Default concentrations used

Animals on block

Ratio and type of stock based on whole farm values due to there being only one enterprise on the farm

Animal grazing

Dairy	%	0
January		True
February		True
March		True
April		True
May		True
July		True
August		True
September		True
October		True
November		True
December		True

Water connectivity

Direct access to streams

Effluent Application

Solid effluents

Effluent type added	December	Pond solids/sludge *
Effluent type added	January	Holding pond separated solids
Effluent type added	November	Solids from wintering pad

Block - Puke_6a.1Effluent Solid

Block name		Puke_6a.1Effluent Solid
Block type		Pastoral
Area	ha	36.8
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False

Climate

Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default

Soil description		
Soil order (default)		Pallic
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Pukem_6a.1
Wilting point	0 - 30cm	22
	30 - 60cm	25
	> 60	1
Field Capacity	0 - 30cm	40
	30 - 60cm	41
	> 60	2
Saturation	0 - 30cm	54
	30 - 60cm	48
	> 60	3
Natural drainage class		Poor
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.58
Depth to impeded layer	cm	58
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		22
Sand	%	9
Bulk density	kg/m^3	1220
Clay	%	28
Sub soil clay	%	29
Soil profile		
Profile drainage class		Use default
Stony top soil		False
Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.00
Maximum rooting depth		0.58
Soil drainage		
Drainage Method		
Method		None
Hydrophobic condition		Use default

Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		
N immobilisation status		
Soil tests		

Olsen P	QT K	QT Ca	QT Mg	QT Na
35.0	8.0	10.0	22.0	8.0

QT SO4		5
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		1000
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100

Fertiliser products - October	
Category	User defined
Product	Eff - Urea + Se
Amount	61
Fertiliser products - September	
Category	User defined
Product	UREA BULK
Amount	70
Fertiliser products - February	
Category	User defined
Product	UREA BULK
Amount	40
Fertiliser products - December	
Category	User defined
Product	UREA BULK
Amount	40
Fertiliser products - March	
Category	Ravensdown other
Product	Urea
Amount	60
Fertiliser products - April	
Category	Ravensdown other
Product	Urea
Amount	50
Fertiliser products - May	
Category	Ravensdown other
Product	Urea
Amount	20
Fertiliser products - January	
Category	Ravensdown other
Product	Urea
Amount	60
Fertiliser products - November	
Category	Ravensdown other
Product	Urea
Amount	40
Fertiliser products - December	
Category	Ravensdown other

Product		Potassium chloride
Amount		50

Irrigation

Irrigation concentrations

Default concentrations used

Animals on block

Ratio and type of stock based on whole farm values due to there being only one enterprise on the farm

Animal grazing

Dairy	%	0
January		True
February		True
March		True
April		True
May		True
July		True
August		True
September		True
October		True
November		True
December		True

Water connectivity

Direct access to streams

Effluent Application

Solid effluents

Effluent type added	December	Pond solids/sludge *
Effluent type added	January	Holding pond separated solids
Effluent type added	November	Solids from wintering pad

Block - Riparian Areas

Block name		Riparian Areas
Block type		Riparian
Area	ha	1.2

Block - Waiki_30a.1 Eff Solids

Block name		Waiki_30a.1 Eff Solids
Block type		Pastoral
Area	ha	17.9
Relative productivity		1
Fodder crop rotation		No
Topography		Flat

Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Brown
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Waiki_30a.1
Wilting point	0 - 30cm	21
	30 - 60cm	23
	> 60	25
Field Capacity	0 - 30cm	42
	30 - 60cm	41
	> 60	43
Saturation	0 - 30cm	59
	30 - 60cm	52
	> 60	49
Natural drainage class		Well
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.00
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		43
Sand	%	4
Bulk density	kg/m^3	1090
Clay	%	28
Sub soil clay	%	28
Soil profile		
Profile drainage class		Use default
Stony top soil		False

Sub-soil textural group					
Depth to non-standard layer					0.00
Depth to impeded drainage layer					0.00
Maximum rooting depth					0.00
Soil drainage					
Drainage Method					
Method					None
Hydrophobic condition					Use default
Occurence of pugging damage					Occasional
Compacted top soil					False
Soil settings					
K leaching potential not set					
N immobilisation status					
Soil tests					
Olsen P	QT K	QT Ca	QT Mg	QT Na	
30.0	7.0	10.0	20.0	9.0	
QT SO4					5
Anion storage capacity or phosphate retention					Not entered
TBK reserve K test					Not entered
K reserve status					Use default
Advanced soil settings					
Organic matter status					
Bulk density				kg/m³	0
Structural integrity					0
Carbon				%	0
Clay				%	0
Sand				%	Not entered
Sub soil clay				%	Not entered
Saturated Conductivity				mm/day	Default
QT pH					0
Pasture					
Pasture type					Ryegrass/white clover
Clover levels					
Pasture utilisation				%	0
Average annual pasture N content				%	0
Supplements removed					
No supplements removed from this block					
Fertiliser application					

Fertiliser products - December	
Category	User defined
Product	2/3 Super & Lime
Amount	1000
Fertiliser products - August	
Category	Ravensdown cropping
Product	Ammo 36
Amount	100
Fertiliser products - October	
Category	User defined
Product	Eff - Urea + Se
Amount	61
Fertiliser products - September	
Category	User defined
Product	UREA BULK
Amount	70
Fertiliser products - February	
Category	User defined
Product	UREA BULK
Amount	40
Fertiliser products - December	
Category	User defined
Product	UREA BULK
Amount	40
Fertiliser products - March	
Category	Ravensdown other
Product	Urea
Amount	60
Fertiliser products - April	
Category	Ravensdown other
Product	Urea
Amount	50
Fertiliser products - May	
Category	Ravensdown other
Product	Urea
Amount	20
Fertiliser products - January	
Category	Ravensdown other

Product		Urea
Amount		60
Fertiliser products - November		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - December		
Category		Ravensdown other
Product		Potassium chloride
Amount		50
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Ratio and type of stock based on whole farm values due to there being only one enterprise on the farm		
Animal grazing		
Dairy	%	0
January		True
February		True
March		True
April		True
May		True
July		True
August		True
September		True
October		True
November		True
December		True
Water connectivity		
Direct access to streams		
Effluent Application		
Solid effluents		
Effluent type added	December	Pond solids/sludge *
Effluent type added	January	Holding pond separated solids
Effluent type added	November	Solids from wintering pad
Block - Waiki_30a.1 Run Off		
Block name		Waiki_30a.1 Run Off
Block type		Pastoral

Area	ha	23.7
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Brown
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Waiki_30a.1
Wilting point	0 - 30cm	21
	30 - 60cm	23
	> 60	25
Field Capacity	0 - 30cm	42
	30 - 60cm	41
	> 60	43
Saturation	0 - 30cm	59
	30 - 60cm	52
	> 60	49
Natural drainage class		Well
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.00
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	
Top soil horizon chemical and physical parameters		
ASC/PR		43
Sand	%	4
Bulk density	kg/m^3	1090
Clay	%	28

Sub soil clay	%	28
Soil profile		
Profile drainage class		Use default
Stony top soil		False
Sub-soil textural group		
Depth to non-standard layer		0.00
Depth to impeded drainage layer		0.00
Maximum rooting depth		0.00
Soil drainage		
Drainage Method		
Method		None
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching potential not set		
N immobilisation status		
Soil tests		

Olsen P	QT K	QT Ca	QT Mg	QT Na
27.0	9.0	9.0	16.0	10.0

QT SO4		10
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0

Average annual pasture N content	%	0
Supplement removed		
Supplement information		
Conservation type		Baleage
Name		
Pasture type		
Wrapping	Wrapped in plastic	
Supplement amount		
Dry weight basis	T	20
Destination		Storage
Storage conditions		Average
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		1000
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		61
Fertiliser products - September		
Category		User defined
Product		UREA BULK
Amount		70
Fertiliser products - February		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - December		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - March		
Category		Ravensdown other

Product		Urea
Amount		60
Fertiliser products - April		
Category		Ravensdown other
Product		Urea
Amount		50
Fertiliser products - May		
Category		Ravensdown other
Product		Urea
Amount		20
Fertiliser products - January		
Category		Ravensdown other
Product		Urea
Amount		60
Fertiliser products - November		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - December		
Category		Ravensdown other
Product		Potassium chloride
Amount		50
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Ratio and type of stock based on whole farm values due to there being only one enterprise on the farm		
Animal grazing		
Dairy	%	0
January		True
February		True
March		True
April		True
May		True
August		True
September		True
October		True
November		True

December		True
Water connectivity		
Direct access to streams		
Effluent Application		
Solid effluents		
Effluent type added	December	Pond solids/sludge *
Effluent type added	January	Holding pond separated solids
Effluent type added	November	Solids from wintering pad
Block - Parah_4a.1 Eff solids		
Block name		Parah_4a.1 Eff solids
Block type		Pastoral
Area	ha	2.7
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Pallic
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Parah_4a.1
Wilting point	0 - 30cm	24
	30 - 60cm	26
	> 60	27
Field Capacity	0 - 30cm	38
	30 - 60cm	38
	> 60	39
Saturation	0 - 30cm	50
	30 - 60cm	46
	> 60	44
Natural drainage class		Imperfect
Top soil texture		Unknown

Is Stony		False
Maximum rooting depth	cm	0.00
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	

Top soil horizon chemical and physical parameters

ASC/PR		23
Sand	%	12
Bulk density	kg/m³	1220
Clay	%	34
Sub soil clay	%	34

Soil profile

Profile drainage class	Use default
Stony top soil	False
Sub-soil textural group	
Depth to non-standard layer	0.00
Depth to impeded drainage layer	0.00
Maximum rooting depth	0.00

Soil drainage

Drainage Method	
Method	None
Hydrophobic condition	Use default
Occurence of pugging damage	Occasional
Compacted top soil	False

Soil settings

K leaching potential not set	
N immobilisation status	

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30.0	7.0	10.0	20.0	9.0

QT SO4	5
Anion storage capacity or phosphate retention	Not entered
TBK reserve K test	Not entered
K reserve status	Use default

Advanced soil settings

Organic matter status		
Bulk density	kg/m³	0

Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		1000
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		61
Fertiliser products - September		
Category		User defined
Product		UREA BULK
Amount		70
Fertiliser products - February		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - December		
Category		User defined
Product		UREA BULK

Amount		40
Fertiliser products - March		
Category		Ravensdown other
Product		Urea
Amount		60
Fertiliser products - April		
Category		Ravensdown other
Product		Urea
Amount		50
Fertiliser products - May		
Category		Ravensdown other
Product		Urea
Amount		20
Fertiliser products - January		
Category		Ravensdown other
Product		Urea
Amount		60
Fertiliser products - November		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - December		
Category		Ravensdown other
Product		Potassium chloride
Amount		50
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Ratio and type of stock based on whole farm values due to there being only one enterprise on the farm		
Animal grazing		
Dairy	%	0
January		True
February		True
March		True
April		True
May		True
July		True

August		True
September		True
October		True
November		True
December		True
Water connectivity		
Direct access to streams		
Effluent Application		
Solid effluents		
Effluent type added	December	Pond solids/sludge *
Effluent type added	January	Holding pond separated solids
Effluent type added	November	Solids from wintering pad
Block - Parah_4a.1 Run Off		
Block name		Parah_4a.1 Run Off
Block type		Pastoral
Area	ha	2.9
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Pallic
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Parah_4a.1
Wilting point	0 - 30cm	24
	30 - 60cm	26
	> 60	27
Field Capacity	0 - 30cm	38
	30 - 60cm	38
	> 60	39
Saturation	0 - 30cm	50

	30 - 60cm	46
	> 60	44
Natural drainage class		Imperfect
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.00
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	

Top soil horizon chemical and physical parameters

ASC/PR		23
Sand	%	12
Bulk density	kg/m³	1220
Clay	%	34
Sub soil clay	%	34

Soil profile

Profile drainage class	Use default
Stony top soil	False
Sub-soil textural group	
Depth to non-standard layer	0.00
Depth to impeded drainage layer	0.00
Maximum rooting depth	0.00

Soil drainage

Drainage Method	
Method	None
Hydrophobic condition	Use default
Occurence of pugging damage	Occasional
Compacted top soil	False

Soil settings

K leaching potential not set

N immobilisation status

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
27.0	8.7	8.9	16.0	10.2

Organic S	10.5
Anion storage capacity or phosphate retention	Not entered
TBK reserve K test	Not entered

K reserve status		Use default
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		1000
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		61
Fertiliser products - September		
Category		User defined
Product		UREA BULK
Amount		70
Fertiliser products - February		
Category		User defined
Product		UREA BULK

Amount		40
Fertiliser products - December		
Category		User defined
Product		UREA BULK
Amount		40
Fertiliser products - March		
Category		Ravensdown other
Product		Urea
Amount		60
Fertiliser products - April		
Category		Ravensdown other
Product		Urea
Amount		50
Fertiliser products - May		
Category		Ravensdown other
Product		Urea
Amount		20
Fertiliser products - January		
Category		Ravensdown other
Product		Urea
Amount		60
Fertiliser products - November		
Category		Ravensdown other
Product		Urea
Amount		40
Fertiliser products - December		
Category		Ravensdown other
Product		Potassium chloride
Amount		50
Irrigation		
Irrigation concentrations		
Default concentrations used		
Animals on block		
Ratio and type of stock based on whole farm values due to there being only one enterprise on the farm		
Animal grazing		
Dairy	%	0
January		True
February		True

March		True
April		True
May		True
August		True
September		True
October		True
November		True
December		True
Water connectivity		
Direct access to streams		
Effluent Application		
Solid effluents		
Effluent type added	December	Pond solids/sludge *
Effluent type added	January	Holding pond separated solids
Effluent type added	November	Solids from wintering pad
Block - Apar_2a.1 Eff solids Lease		
Block name		Apar_2a.1 Eff solids Lease
Block type		Pastoral
Area	ha	4.5
Relative productivity		1
Fodder crop rotation		No
Topography		Flat
Distance from coast	km	25
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1096
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm; Low
Annual potential evapotranspiration	mm/yr	712
Seasonal variation in PET		Use default
Soil description		
Soil order (default)		Brown
Soil group (default)		Recent/YGE/BGE
SMaps	Sibling	Apar_2a.1
Wilting point	0 - 30cm	23
	30 - 60cm	26
	> 60	1
Field Capacity	0 - 30cm	45

	30 - 60cm	42
	> 60	2
Saturation	0 - 30cm	63
	30 - 60cm	53
	> 60	3
Natural drainage class		Imperfect
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0.58
Depth to impeded layer	cm	0
Soil texture group		
Non-standard layer		
Depth to non-standard layer	cm	

Top soil horizon chemical and physical parameters

ASC/PR		43
Sand	%	6
Bulk density	kg/m³	1090
Clay	%	25
Sub soil clay	%	28

Soil profile

Profile drainage class	Use default
Stony top soil	False
Sub-soil textural group	
Depth to non-standard layer	0.00
Depth to impeded drainage layer	0.00
Maximum rooting depth	0.58

Soil drainage

Drainage Method	
Method	None
Hydrophobic condition	Use default
Occurence of pugging damage	Occasional
Compacted top soil	False

Soil settings

K leaching potential not set

N immobilisation status

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30.0	7.0	10.0	20.0	9.0

QT SO4		5
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Advanced soil settings		
Organic matter status		
Bulk density	kg/m³	0
Structural integrity		0
Carbon	%	0
Clay	%	0
Sand	%	Not entered
Sub soil clay	%	Not entered
Saturated Conductivity	mm/day	Default
QT pH		0
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		
Pasture utilisation	%	0
Average annual pasture N content	%	0
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - December		
Category		User defined
Product		2/3 Super & Lime
Amount		1000
Fertiliser products - August		
Category		Ravensdown cropping
Product		Ammo 36
Amount		100
Fertiliser products - October		
Category		User defined
Product		Eff - Urea + Se
Amount		61
Fertiliser products - September		
Category		User defined
Product		UREA BULK
Amount		70

Fertiliser products - February

Category	User defined
Product	UREA BULK
Amount	40

Fertiliser products - December

Category	User defined
Product	UREA BULK
Amount	40

Fertiliser products - March

Category	Ravensdown other
Product	Urea
Amount	60

Fertiliser products - April

Category	Ravensdown other
Product	Urea
Amount	50

Fertiliser products - May

Category	Ravensdown other
Product	Urea
Amount	20

Fertiliser products - January

Category	Ravensdown other
Product	Urea
Amount	60

Fertiliser products - November

Category	Ravensdown other
Product	Urea
Amount	40

Fertiliser products - December

Category	Ravensdown other
Product	Potassium chloride
Amount	50

Irrigation

Irrigation concentrations

Default concentrations used

Animals on block

Ratio and type of stock based on whole farm values due to there being only one enterprise on the farm

Animal grazing

Dairy	%	0
January		True
February		True
March		True
April		True
May		True
July		True
August		True
September		True
October		True
November		True
December		True
Water connectivity		
Direct access to streams		
Effluent Application		
Solid effluents		
Effluent type added	December	Pond solids/sludge *
Effluent type added	January	Holding pond separated solids
Effluent type added	November	Solids from wintering pad