

# **Appendix N – Management Plan**



## **MANAGEMENT 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](mailto: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 neighbouring farms.

## **4. Nutrient Budget**

## **5. Good Management Practices**

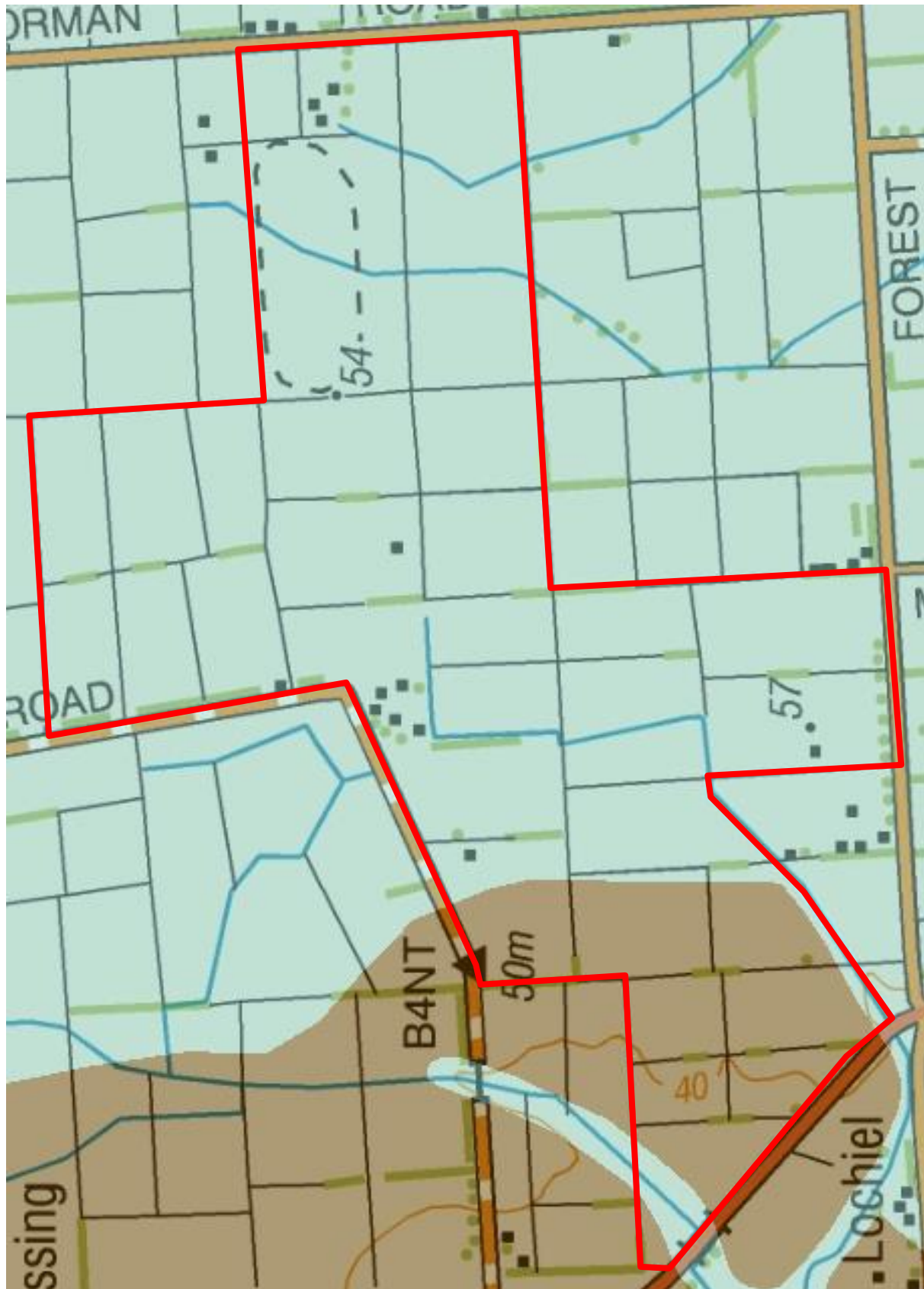
## **6. Riparian Management Plan**

## **7. Cultivation**

## **8. Intensive Winter Grazing**

## **9. Collected Agricultural Effluent Effluent Management Plan**

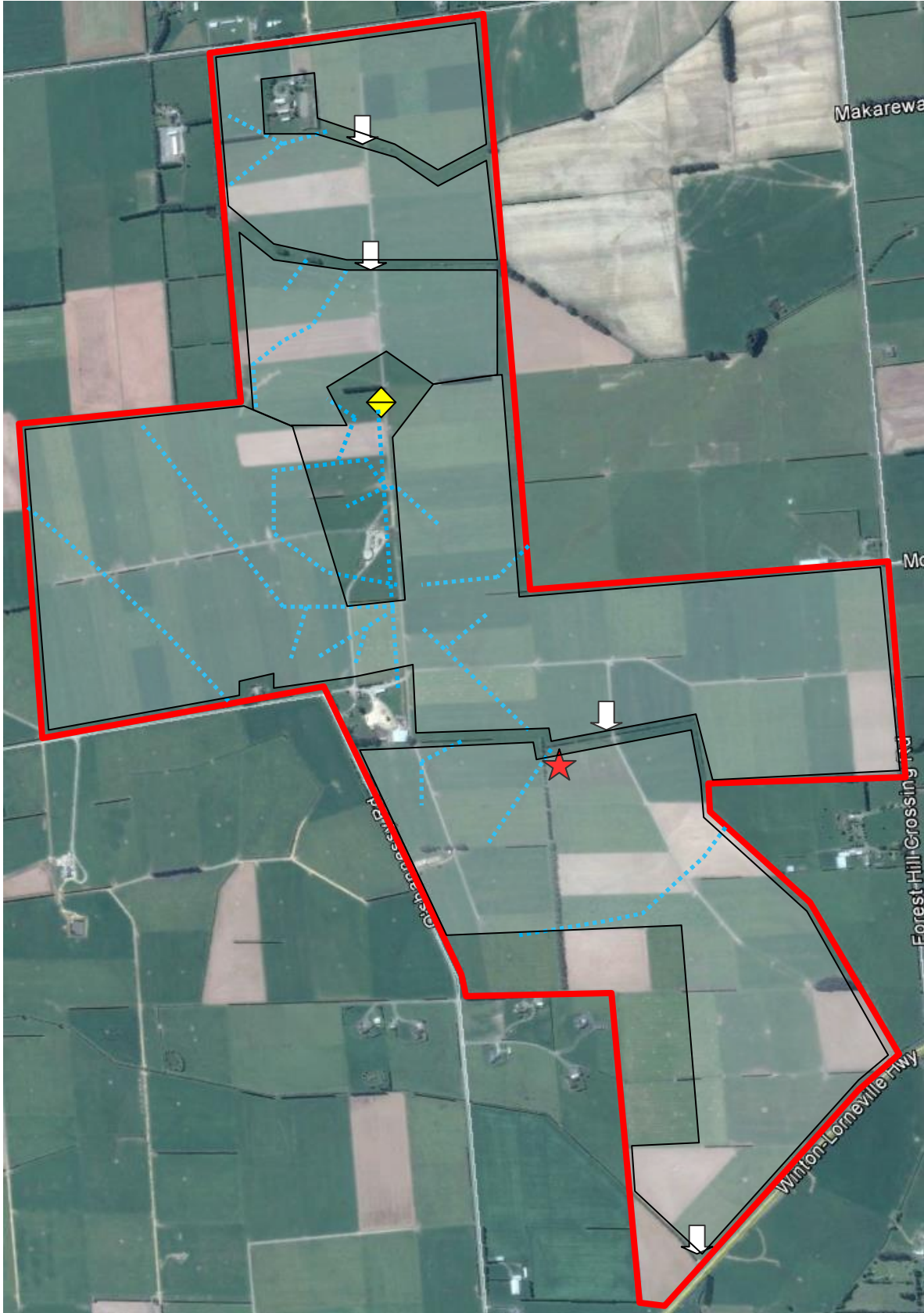
PHYSIOGRAPHIC MAP



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.

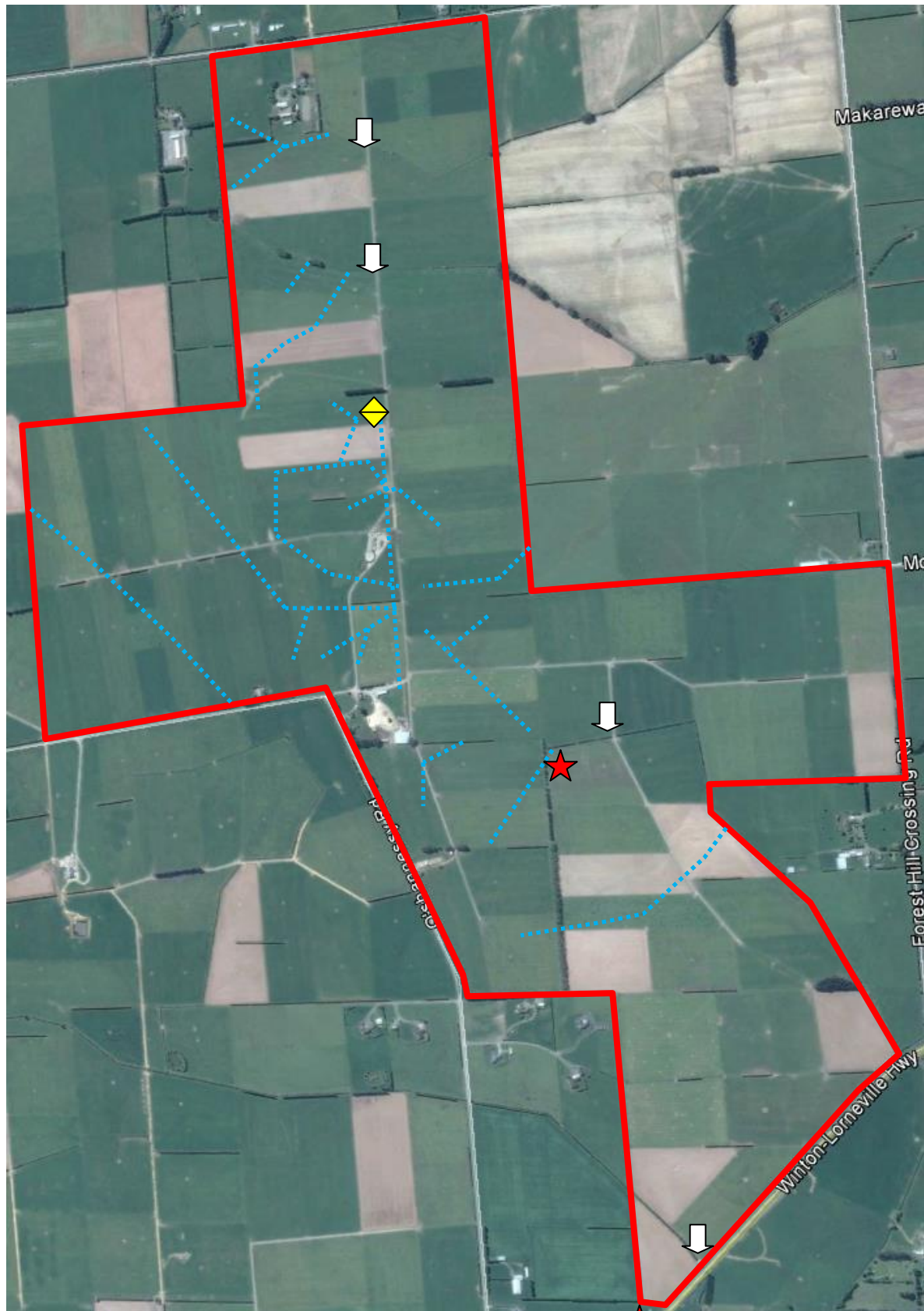
The key transport pathways and contaminants for this physiographic zone is overland flow and artificial drainage

The farm has 80% less than 7 degrees and 20% greater than 7 degrees. 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 minimize pasture damage.



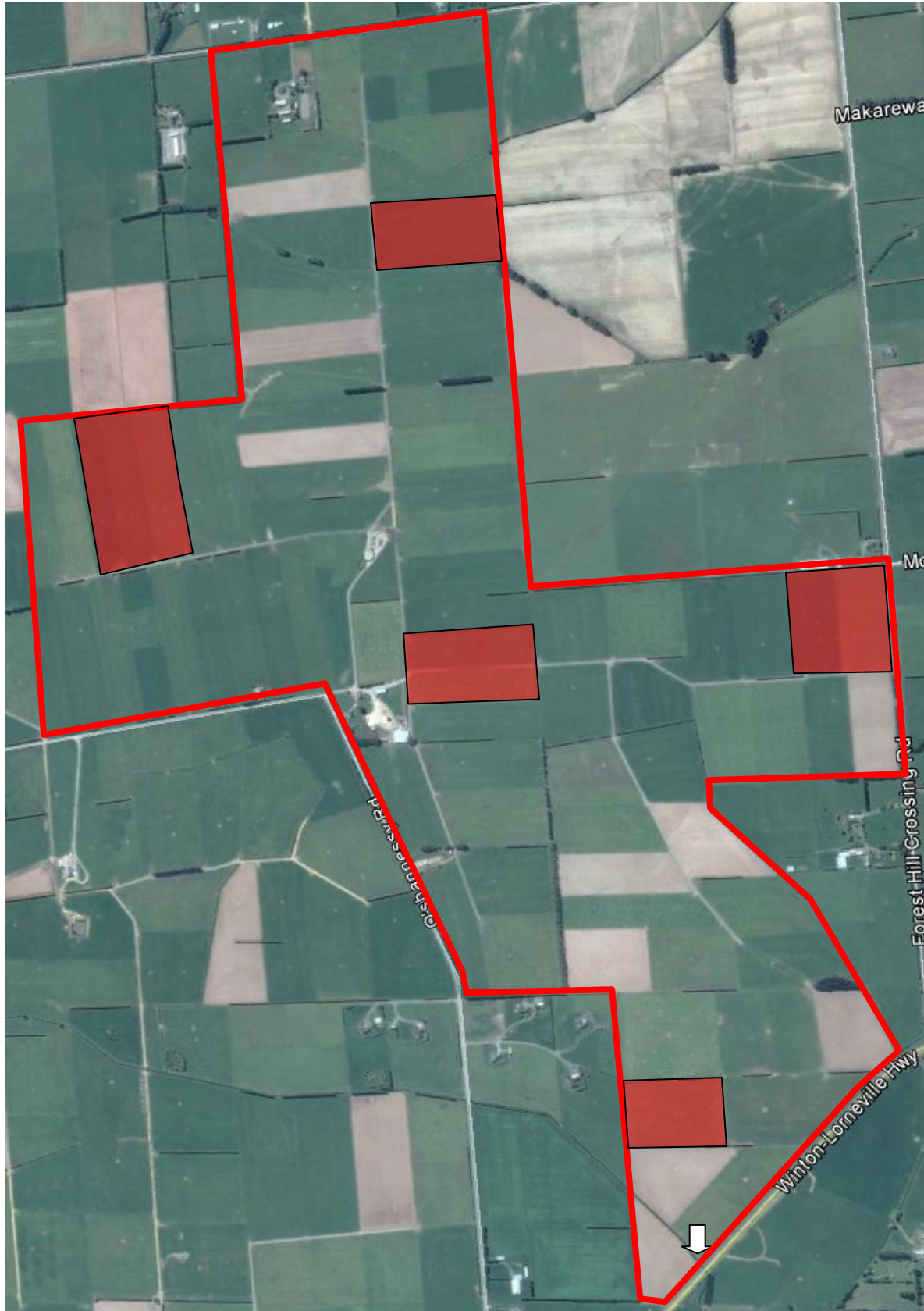


- Property boundary
- Discharge area
- Open stream
- Intermittent drain
- Critical source area
- Bridge or culvert
- Bore
- Tiles

- 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**

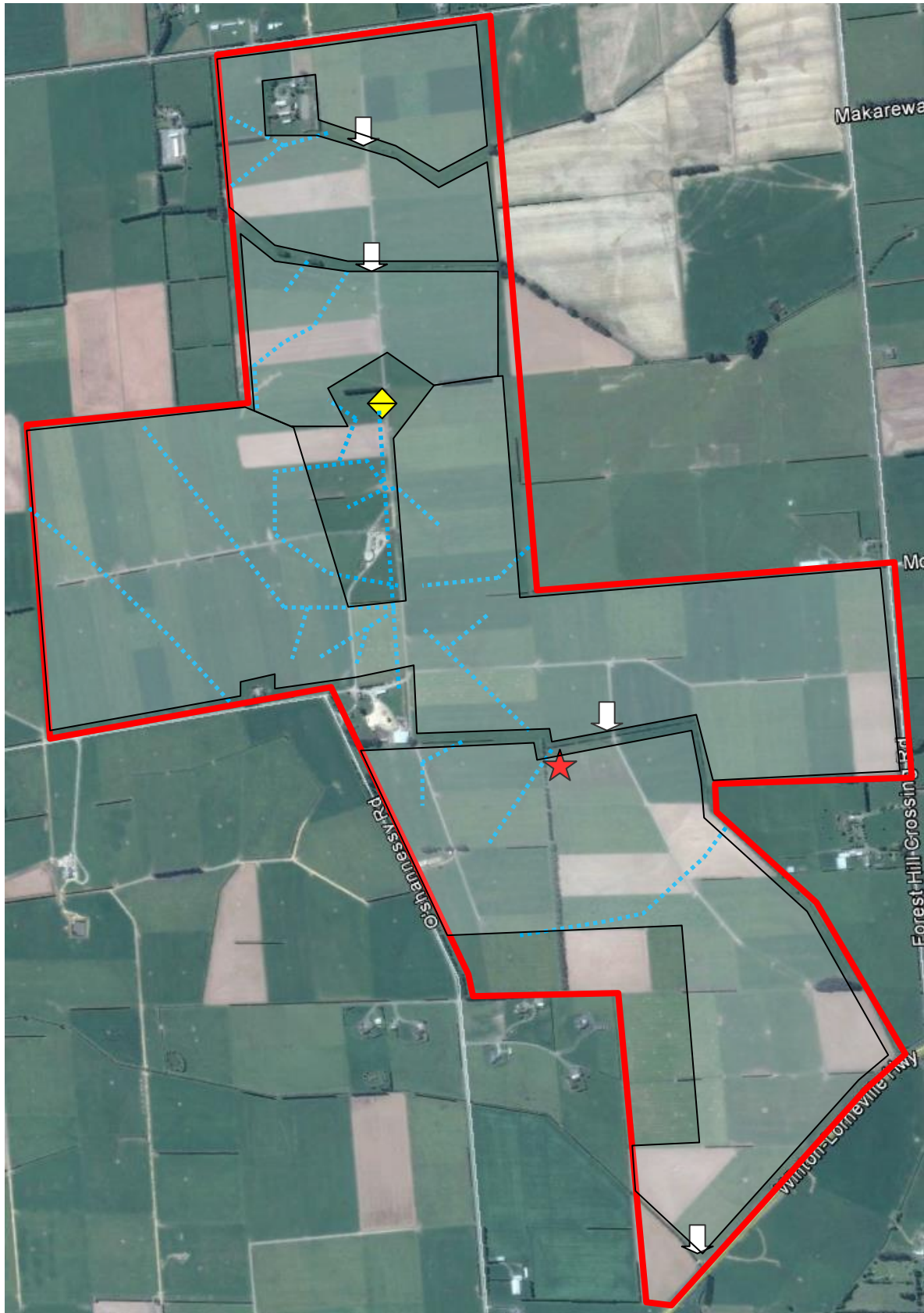
- Identify any tiles and outlets.
- Identify additional critical source areas where storm water runs in heavy rain.
- The farm will check that the riparian strips are adequate and that fences are the correct distance from waterways.
- Ensure all fences keep stock out of water.
- Fence known critical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



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

1 June 2017 to 31 May 2018





- 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.

# Submission

To: The Chief Executive  
Environment Southland  
Private Bag 90116  
DX20175  
Invercargill

## SUBMISSION FORM

Submission on a Notified Application for a Resource Consent

I: LAWRENCE CAMERON (Name(s))  
of: 812 SUB STATION ROAD LOCHIEL (Address)  
at: 0211 900 700 (Phone) (Fax) (E-mail)

Wish to ~~SUPPORT~~ / **OPPOSE** / ~~submit a NEUTRAL~~ submission on (circle one) the application of:

Name: SOUTH DAIRY LTD

And/or Organisation: \_\_\_\_\_

Application Number: 20171302 Location: 373 O'SHANNESSEY RD  
LOCHIEL

My reasons for my submission are: (State the nature of your submission and give clear reasons. Continue on attached pages if necessary)

I OBJECT TO MORE COWS BEING  
INTRODUCED TO THE AREA FOR  
DAIRY FARMING PURPOSES.

I LIVE IN THE LOCHIEL DISTRICT  
AND RELY ON CLEAN AIR AND  
WATER FOR MY EXISTENCE.

WE ALL KNOW DAIRYING IS AT OVER  
CAPACITY ALREADY.

THE ONLY PEOPLE THAT WANT MORE  
COWS ARE DAIRY FARMERS.

NO ONE ELSE WANTS MORE  
COWS.

I wish the Council to make the following decision (Give precise details, including the nature of any conditions sought)

I WOULD LIKE THE COUNCIL TO DECLINE THE APPLICATION FOR MORE COWS AND REVIEW THE CONSENT THAT IS EXISTING, WITH THE AIM OF REDUCING THE NUMBER OF COWS ALREADY BEING FARMED BY THIS COMPANY.

PLEASE DO THE RIGHT THING - DECLINE.

I, ~~am~~/am not (choose one) a trade competitor\* of the applicant (for the purposes of Section 308B of the Resource Management Act 1991).

\*If trade competitor chosen, please complete the next statement, otherwise leave blank

I, am/am not (choose one) directly affected by an effect as a result of the proposed activity in the application that:

- (a) adversely affects the environment; and
- (b) does not relate to trade competition or the effects of trade competition.

I, ~~do~~/do not (choose one) wish to be heard in support of my submission.

I, do/~~do not~~ (choose one) wish to be involved in any pre-hearing meeting that may be held for this application.

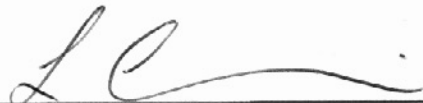
I have served a copy of my submission on the applicant.

Yes

No

BY POST :

Signed



Date

12-09-17

If you have any queries about this form or its purpose please contact the Consents Division of Environment Southland (03) 211 5115 or 0800 76 88 45.



## Emily Allan

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**From:** Emily Allan  
**Sent:** Tuesday, 19 December 2017 5:14 PM  
**To:** 'Lawrence Cameron'  
**Subject:** RE: APP 20171302 / South Dairy Ltd

Hi Lawrence,

Thank you for this email requesting to be heard at the hearing for South Dairy Ltd application (APP-20171302). I will keep you in the loop with regards to any additional information that I get from the applicant, dates for the hearing, contact details for the panel assistant when this appointment is made, and advise you who the commissioners are when this decision has been made.

If you have any questions regarding the hearing process, please do not hesitate to call or email me.

Kind Regards,  
Emily

-----Original Message-----

From: Lawrence Cameron [mailto:southlandsuperannuation@gmail.com]  
Sent: Tuesday, 19 December 2017 4:51 p.m.  
To: Emily Allan  
Subject: APP 20171302 / South Dairy Ltd

Hi Emily

This e-mail serves to confirm to you that i wish to attend the hearing for the above application as discussed with you today on the phone

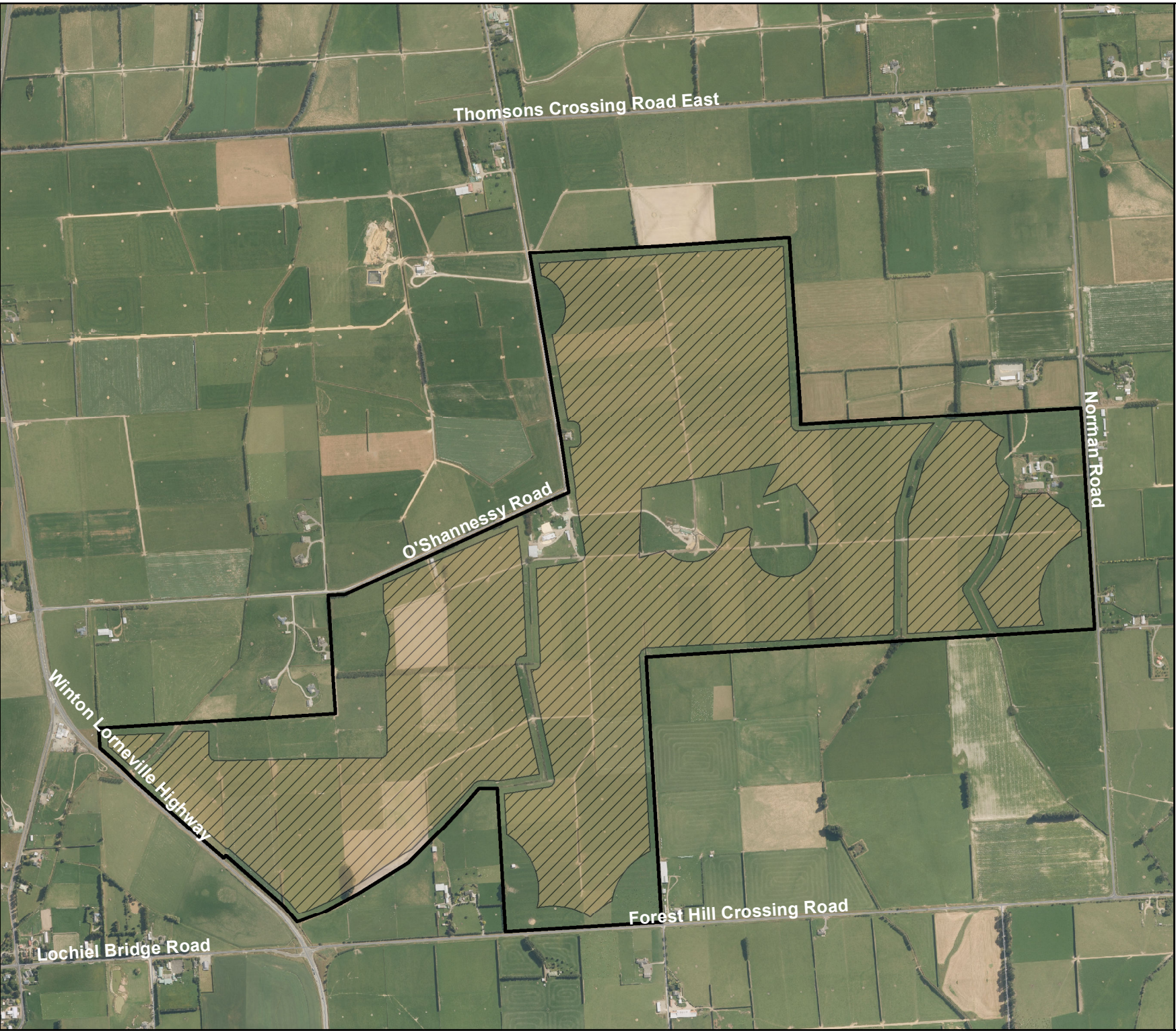
I am available any time.



Regards  
Lawrence Cameron

# **Appendix 1 – Map**



# Appendix 1



-  Dairyshed Effluent
-  Farm Boundaries



1:15,000

While every effort has been made to ensure the content is correct. Environment Southland cannot guarantee the accuracy of the data. This information should not be reused in any manner without consultation.

DATA SOURCE: ES GIS 2017

# Further Information



Our reference: APP-20171302  
Enquiries to: Emily Allan  
Email: Emily.Allan@es.govt.nz

21 June 2017

South Dairy Limited  
C/- D C & S M Alexander  
373 O'Shannessy Road  
RD 1  
Winton 9781



Dear Sir/Madam,

***Request for Further Information under Section 92(1) of the Resource Management Act 1991 - Application for a discharge permit, a land use consent and a water permit.***

Thank you for lodging an application to discharge dairy shed effluent from up to 750 cows to land by cobra rain gun, slurry tanker or umbilical system, to take up to 90,000 l/day of groundwater and expand a dairy farm at O'Shannessy Road, Lochiel. I require further information before a determination can be made on your application.

Please provide[1], in accordance with Section 92(1) of the Resource Management Act, the following information:

**Overseer And Application Details**

- Confirmation that all 750 cows and other stock will be wintered off farm.
  - Alternatively, if the applicant is intending to winter on farm please explain the amount of stock/stock type and crop area/type and if this has been modelled in Overseer.
- Confirmation that the proposed number of cows will be 750, not 780 which has been modelled in Overseer.
- Electronic Overseer files for the scenarios modelled in the application. I require this information to be able to consider the nutrient budgets provided with the application. This is also to ensure that the budgets have been completed in accordance with the relevant guidelines.
- An explanation for the nitrogen attenuation figure used in the application on page 28 as 97% seems very high. This is important for understanding the effects of the activity.

**Good Management Practices**

- While I can see that you have included some general good management practices (GMP's) on page 20 and page 36 of the application, further details are required. Could you please provide clarification for what you are proposing as GMP's and what you are proposing as mitigations. With regards to the mitigations, please identify why these are going above good management practice and assess the effectiveness of these mitigation measures.

## Assessment of Effects

- Identify the effects of the application when comparing the current activity with GMP's to the proposed scenario. This is necessary to establish the existing environment for the site.
- An assessment of the effects with regards to sediment loss, microbial loss and the total nutrient loss from using the land for dairy farming, not just the aerial load from the collected effluent, on water quality and soil health in the receiving environment and the values associated with it (including Iwi values and values included in Policy 31C of the Regional Water Plan – RWP).
  - I require this information in order to understand what the effects of the activity are likely to be on the receiving environment. Whilst Overseer presents a scenario, the effect on the values of the receiving environment of the 'losses' need to be assessed.
  - In the application (page 28) a table has been included with regards to Oreti Catchment Nitrogen Load using a number of modelling tools. Could you please assess the effect of the proposed activity on the cumulative losses represented in this table. How does this relate to objectives 2, 8 and 9C of the RWP.

## Policy Assessment

- An explanation for why the application is consistent or inconsistent with Policy 15 and Policy 16 of the proposed Southland Water and Land Plan (pSWLP). On page 10 of the application, it is stated that the application is consistent with these policies. However, I consider that a thorough assessment should be undertaken as this policy provides a strong direction on the granting of resource consents for additional dairy farming of cows. This assessment needs to identify and detail how the application is consistent with these policies with regards to the assessment of effects and the proposed mitigations. I am requiring this information because:
  - Schedule 4 of the RMA states that all applications must include an assessment of the activity against any relevant provisions of a document referred to in section 104(1)(b) and that the assessment under sub-clause (1)(g) must include an assessment of the activity against any relevant objectives, policies, or rules in a document including those in a proposed plan.

## Effluent System Details and Dairy Effluent Storage Calculator

- Confirmation of the proposed pond volume as multiple figures have been used in the application, is this 3,060 or 5,060 cubic metres?
- An explanation for how the effluent system will operate in the interim before the new effluent storage is constructed and is operational. What contingency measures are in place to mitigate any interim effects?
- An explanation for how the proposed storage volumes are consistent with deferred storage as determined by the Massey Pond Calculator.
- An explanation of the inputs into the Dairy Effluent Storage Calculator and adjustment to the inputs if required as follows:
  - The minimum effluent block has been put at 20ha rather than 60ha which is consistent with 8ha/100 cows as a best practice guide. Could you please provide a revised calculation which matches the value in Overseer needed to achieve 150kg/N/year or the best practice guide, or provide a suitable explanation for why 20ha is appropriate.

I require the above information in order to determine the relevant rules and to audit the potential effects of the activities that have been applied for. The determination of the application is postponed until receipt of this information.

Under Section 92A of the RMA you have until 15 working days from the date of this request, which we calculate to be **12 July 2017**, to either provide the information, tell the Council, in writing, either that you agree to provide the information or that you refuse to provide the information.

If you refuse to provide the information requested, or if you do not respond to this request, the Council may decline the application on the grounds that it has inadequate information to determine the application.

Please contact me if you have any questions regarding this request.

Yours sincerely



Emily Allan  
**Consents Officer**

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[1] Under Section 92(1) of the Resource Management Act 1991 (RMA) the Council may, at any time before the hearing of an application, or if no hearing is to be held, before the decision to grant or refuse the application is made, request in writing that the applicant provide further information relating to the application.

Our reference: APP-20171302  
Enquiries to: Emily Allan  
Email: Emily.Allan@es.govt.nz



21 June 2017

Civil Tech Limited  
PO Box 1558  
Invercargill 9840

Dear Murray,

***Request for Further Information under Section 92(1) of the Resource Management Act 1991 - Application for a discharge permit, a land use consent and a water permit.***

Thank you for lodging an application to discharge dairy shed effluent from up to 750 cows to land by cobra rain gun, slurry tanker or umbilical system, to take up to 90,000 l/day of groundwater and expand a dairy farm at O'Shannessy Road, Lochiel. I require further information before a determination can be made on your application.

Please provide[1], in accordance with Section 92(1) of the Resource Management Act, the following information:

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**Assessment of Effects**

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- An assessment of the effects with regards to sediment loss, microbial loss and the total nutrient loss from using the land for dairy farming, not just the aerial load from the collected effluent, on water quality and soil health in the receiving environment and the values associated with it (including Iwi values and values included in Policy 31C of the Regional Water Plan – RWP).
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### **Policy Assessment**

- An explanation for why the application is consistent or inconsistent with Policy 15 and Policy 16 of the proposed Southland Water and Land Plan (pSWLP). On page 10 of the application, it is stated that the application is consistent with these policies. However, I consider that a thorough assessment should be undertaken as this policy provides a strong direction on the granting of resource consents for additional dairy farming of cows. This assessment needs to identify and detail how the application is consistent with these policies with regards to the assessment of effects and the proposed mitigations. I am requiring this information because:
  - Schedule 4 of the RMA states that all applications must include an assessment of the activity against any relevant provisions of a document referred to in section 104(1)(b) and that the assessment under sub-clause (1)(g) must include an assessment of the activity against any relevant objectives, policies, or rules in a document including those in a proposed plan.

### **Effluent System Details and Dairy Effluent Storage Calculator**

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- An explanation of the inputs into the Dairy Effluent Storage Calculator and adjustment to the inputs if required as follows:
  - The minimum effluent block has been put at 20ha rather than 60ha which is consistent with 8ha/100 cows as a best practice guide. Could you please provide a revised calculation which matches the value in Overseer needed to achieve 150kg/N/year or the best practice guide, or provide a suitable explanation for why 20ha is appropriate.

I require the above information in order to determine the relevant rules and to audit the potential effects of the activities that have been applied for. The determination of the application is postponed until receipt of this information.

Under Section 92A of the RMA you have until 15 working days from the date of this request, which we calculate to be **12 July 2017**, to either provide the information, tell the Council, in writing, either that you agree to provide the information or that you refuse to provide the information.

If you refuse to provide the information requested, or if you do not respond to this request, the Council may decline the application on the grounds that it has inadequate information to determine the application.

Please contact me if you have any questions regarding this request.

Yours sincerely



Emily Allan  
**Consents Officer**

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[1] Under Section 92(1) of the Resource Management Act 1991 (RMA) the Council may, at any time before the hearing of an application, or if no hearing is to be held, before the decision to grant or refuse the application is made, request in writing that the applicant provide further information relating to the application.

Your reference: App-20171209  
14 August 2017

The General Manager  
Environment Southland  
Private Bag 90116  
INVERCARGILL

Attention: Ms E Allan

Dear Emily

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

Please find below our response to your request for further information on the recent application.

This covers your points raised in your letter on 21 June under section 92(1) of the RMA.

Each of your queries have been addressed in turn.

**1. Overseer and Application Details**

- Confirmation that all 750 cows and other stock will be wintered off farm.
  - Alternatively, if the applicant is intending to winter on farm please explain the amount of stock/stock type and crop area/type and if this has been modelled in Overseer.

All 750 cows and other stock will be wintered off the farm. This is the mitigation measure we have recently agreed with Environment Southland as one of the consent conditions to reduce the losses from the farm.

- Confirmation that the proposed number of cows will be 750, not 780 which has been modelled in Overseer.

Yes, the proposed number of cows will be 750.

- Electronic Overseer files for the scenarios modelled in the application. I require this information to be able to consider the nutrient budgets provided with the application. This is also to ensure that the budgets have been completed in accordance with the relevant guidelines.

Overseer files have been attached.

- An explanation for the nitrogen attenuation figure used in the application on page 28 as 97% seems very high. This is important for understanding the effects of the activity.

There are a number of methods for estimating the nitrogen and phosphorous attenuation, and subsequent losses to the environment. In the application we have referred to three and we have adopted the (most) conservative figures for the purposes of estimating the attenuation in this application. These are summarised below.

Method	Attenuation		Reference
	Nitrogen	Phosphorous	
<b>Houlbrooke</b>	93%		Houlbrooke, D., Longhurst, B., Laurensen, S and Wilson, T. (2014). <i>Benchmarking N and P loss from dairy effluent derived nutrient sources</i>
<b>Wilson</b>	97%	65%	Wilson, K (2016). <i>Technical Water Assessments</i>

We have chosen the most conservative figures – 93% and 65% for nitrogen and phosphorous attenuation respectively. If Environment Southland have a method and details of the amount of attenuation that they use internally and would prefer we use for this application, please advise us.

## 2. Good Management Practices

With regards to the mitigations, please identify why these are going above good management practice and assess the effectiveness of these mitigation measures.

There is no definitive guide or reference of GMPs and mitigation measures for the Southland region so in the application we classify the measures for the South Dairy Farm into GMPs and mitigations based on the Canterbury Matrix of Good Management (MGM). The appropriateness of this benchmark for use in Southland has been suggested in an independent report by Irricon consultants in May 2017.

*“... The MGM Project was a collaboration between several Primary Industry partners and Environment Canterbury to define what GMP looks like on farm in relation to water quality. Prior to this project there were no commonly agreed definitions of GMP... ...Although the MGM Project was designed for Canterbury, the GMP's outlined in the report are applicable to most areas within New Zealand.” Phillips (2017)<sup>1</sup>*

➤ While I can see that you have included some general good management practices (GMP's) on page 20 and page 36 of the application, further details are required. Could you please provide clarification for what you are proposing as GMP's and what you are proposing as mitigations.

As described above, we have used the MGM as a reference for GMPs and mitigation measures. These are listed again below with further details relating to each management practice and mitigation measure.

<sup>1</sup> Phillips N., Johnston, K. (2017) *Overseer Modelling Report for Environment Southland*. Irricon resource solutions

## Good Management Practices

This coming season and ongoing we will implement all of the following good management practices (GMPs).

*Table 1 South Dairy Good management practices this coming season and ongoing*

Activity	Relationship to risks with physiographic zones	Additional detail
<b>Nutrient management plans</b>	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.	
<b>Optimum soil test P</b>	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. Each paddock tested every year.	This was started in 2017 and is now part of the farm management plan going forward.
<b>Stock exclusion from streams and wetlands</b>	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.	All waterways are fenced and have been for many years.
<b>Tracks and lane site away from water</b>	Limit faecal contamination or phosphorous run-off into the waterways, and limit sediment and erosion effects from stock.	There are no lanes adjacent to waterways
<b>Limited N fertiliser use</b>	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	As per the nutrient budget, there will be no fertiliser spread between March and August.
<b>Grass buffers</b>	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.	All of the waterways are fenced, with mature grasses and plantings.
<b>Restricted grazing of cropland, some still planted for pasture renewal</b>	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.	There will be no grazing in winter. Previously there has been winter grazing on the farm and the new block of land.
<b>Pugged soil resown</b>	Ensure high ability of soil to use available nutrients and productive capacity.	Pugged soils are resown as soon as practical.

## Mitigation Measures

We have considered the following mitigation measures for implementing on farm. The proposal includes all of the dairy cows being wintered off the farm.

Table 2 South Dairy – Appropriate mitigation measures

Activity	Relationship to risks with physiographic zones	Additional detail
<b>Restricted grazing in autumn</b>	Using high carbohydrate feeds with less pasture or silage.	Instead of putting nitrogen on to boost pasture, silage or fodder beet is used to provide energy for the cows.
<b>Using low N feeds</b>	The use of fodder crop to maintain energy level with low N feed.	Yes this will be implemented
<b>Winter off stock</b>	Reduces the risk of nutrient leaching in porous soil, phosphorous and sediment loss via overland flow during wet periods, and soil compaction.	There will be no stock in paddocks during winter.
<b>Restricted grazing of pasture</b>	The use of stand-off/feed/calving pad when soil conditions are wet.	Standoff feedpads are being constructed to hold stock.
<b>No till pasture where possible (direct drilling)</b>	Reduces the risk of soil and sediment loss. Direct drilling of grass to grass where possible.	Some climatic situations during some seasons mean that this may sometimes not be practical, but is the preferred method of sowing wherever possible.
<b>Fertiliser in split dressings</b>	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. Nitrogen is split over seven or eight dressings.	This will be introduced as an on-farm practice in 2017.
<b>Feed / standoff pads to keep cows of wet ground</b>	Control the damage to pasture, and when effluent is applied to land through use of storage.	These will be constructed in 2017/18.
<b>Calving pad rather than calving on swedes</b>	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.	This will be the same feed/standoff pad.
<b>Low rate effluent</b>	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.	This will be put into place in 2017/18.

## Assessment of Effects

- Identify the effects of the application when comparing the current activity with GMP's to the proposed scenario. This is necessary to establish the existing environment for the site.

The application is based on the GMP's being already in place, and the mitigation measures are being implemented in the first season of the new consent.

- An assessment of the effects with regards to sediment loss, microbial loss and the total nutrient loss from using the land for dairy farming, not just the aerial load from the collected effluent, on water quality and soil health in the receiving environment and the values associated with it (including Iwi values and values included in Policy 31C of the Regional Water Plan – RWP).
  - I require this information in order to understand what the effects of the activity are likely to be on the receiving environment. Whilst Overseer presents a scenario, the effect on the values of the receiving environment of the 'losses' need to be assessed.

Assessing the effects of the proposed change in activity we looked for new and pre-existing critical source areas on the farm where nutrients may enter groundwater through deep drainage or other waterways through artificial drainage or overland flow. The sources assessed were:

- direct (from cows),
- indirect (collected agricultural effluent) being applied as fertiliser, and
- other fertilisers.

The risks from accidents or other emergencies are considered to be covered in the farm's existing CAEMP. The losses of nutrients (in particular N and P) from each of these sources to the environment have been modelled in Overseer, and additional mitigations have been modelled and discussed extensively in the application that has been submitted. The sediment and microbes have not been discussed in detail and so are discussed in more detail below.

### Losses of sediment and microbes to the environment.

In particular sediment carries a high level of risk because microbes and insoluble phosphorous attach to the particles and this can be transferred to the surface water by overland flow. The source of sediment and microbes can be soil or effluent particularly during wet weather and periods of high rainfall.

The farm is flat and the dairy farm has high levels of grass cover at 1,400kg/ha minimum and up to 2,600kg / ha in the buffer zones which restricts any run-off.

The potential risk areas have been highlighted below.





The potential risk areas are described briefly and followed by the assessment of effects. These are:

- 1) The bridge that crosses a tributary to the Oreti River (shown in Figure 1) that may be a source of sediment and direct effluent. This may contain microbes and soil that could enter the surface waterway during periods of high rainfall through overland flow.



*Figure 1 Drain looking north east from Winton Lorneville Highway (Google Earth, 2017)*

- 2) The tributary runs between the two paddocks.
- 3) The drain runs along the southern boundary of the new lease block





*Figure 2 Drain facing north east from Winton Lorneville Highway with South Dairy farm on left-hand side of stream (Google Earth, 2017)*

While these are the areas of highest risk, because the fences are established and grass buffers are mature, the effects of losses of sediment and microbes to the proximate waterways are considered to be less than minor. This is supported by findings that grass buffer strips of ~5m can reduce 53% of the Phosphorus (Parkyn, 2004) and 74% of incoming solids and 54% N (Dillaha et al, 1989 as cited in Parkyn, 2004)<sup>2</sup>.

---

<sup>2</sup> Parkyn, S. 2004. *Review of Riparian Buffer Zone Effectiveness* MAF Technical Paper 2004/2005.

Activity: Add 50ha lease block with 150 cows to dairy farm platform			
Status quo	Proposed changes		
The current land use over the past six years has been as a run-off block, for 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 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).	Add 150 cows to the 50ha of land, with a stocking rate of 3.0 cows per hectare.		
<i>Identify possible permanent effects: visual effects, loss of trees and vegetation, shading neighbouring property, soil stability, privacy, stormwater/sewer capacity, traffic generation, landscape changes, effects on water quality/quantity, cultural/spiritual values on iwi, effects on heritage sites/buildings/structures/objects, pollution, loss of recreational values of land etc.</i>			
Environmental effect	Ranking of effect	Avoid/remedy/mitigate effect	AEE action
Increase losses of N and P to environment	Significant	Mitigate effect - investigate necessary measures	Document and action
Losses of sediment at bridge crossing on lease block	None		
Losses of microbes at bridge crossing on lease block	None		
Losses of sediment and microbes to stream on lease block	None	Stream is fenced with mature grasses forming a 3m buffer between the fence and stream. This will ensure that microbes and sediment are trapped and not reach the waterway.	None
Losses of sediment and microbes to stream on southern boundary of lease block	None	Stream is fenced with mature grasses forming a 3m buffer between the fence and stream. This will ensure that microbes and sediment are trapped and not reach the waterway.	None
Losses of sediment and microbes to groundwater from FDE	None		None

o In the application (page 28) a table has been included with regards to Oreti Catchment Nitrogen Load using a number of modelling tools. Could you please assess the effect of the proposed activity on the cumulative losses represented in this table. How does this relate to objectives 2, 8 and 9C of the RWP.

For brevity and to avoid repeating the whole section within the application in Figure 3 that follows, we have cross-referenced the specific policies that we have outlined in the application, to the objectives in the RWP.

Further detail can be provided on specific objectives if required.

Objective	Policy															
	A4 NPSFW	B7 NPSFW	1A Take iwi management plans into account	3 Allow no discharges to surface water bodies that will result in a reduction in water quality	7 Prefer discharge to land	13 Avoid the point source discharge of raw sewage, foul water and untreated agricultural efflu	21 Adverse effects arising from point and non-point source discharges	22 Require, where appropriate, the installation of water measuring devices on all new permits	25 Adverse effects arising from point and non-point source discharges	26 Avoid adverse effects on groundwater quality and quantity arising from bores and wells	28 Manage abstraction of groundwater to avoid significant adverse effects	30 Groundwater abstraction	31A Match the level of management that is required for discharges of contaminants onto or in	31C Manage discharge of contaminants onto land or into land to avoid, remedy or mitigate ad	42 Avoid adverse effects on water quality associated with the application of farm dairy effluen	43 Term of consent
2 - Maintain water quality			y	y	y	y			y				y	y		
8 - Drinking water standard			y	y						y			y	y		
9C - Habitats and ecosystems and other values			y	y									y	y	y	y

Figure 3 Relevant policies outlined in the South Dairy application. The regional water plan refers to related issues, policies and rules for each objective. Where we have referred to a policy in the application and the RWP notes that this policy relates to the objective, the area has been shaded in green above.

## Policy Assessment

- An explanation for why the application is consistent or inconsistent with Policy 15 and Policy 16 of the proposed Southland Water and Land Plan (pSWLP). On page 10 of the application, it is stated that the application is consistent with these policies. However, I consider that a thorough assessment should be undertaken as this policy provides a strong direction on the granting of resource consents for additional dairy farming of cows. This assessment needs to identify and detail how the application is consistent with these policies with regards to the assessment of effects and the proposed mitigations. I am requiring this information because:
  - Schedule 4 of the RMA states that all applications must include an assessment of the activity against any relevant provisions of a document referred to in section 104(1)(b) and that the assessment under sub-clause (1)(g) must include an assessment of the activity against any relevant objectives, policies, or rules in a document including those in a proposed plan.

We agree the intent of the proposed Southland Water and Land Plan is to maintain the overall water quality in Southland (hold the line), and the provisions “strongly discourage” applications where activity has “effects ... that cannot be avoided or fully mitigated”. In recent discussions we have discussed amendments and made changes to the proposal with overall reductions in intensity, and modelled losses of a lower intensity – which we understand satisfies the intent of the proposed plan, and provides detail required by the RMA.

As requested by telephone, a more thorough assessment of effects has been attached.

*Excerpt from S4 of RMA (1993) –*

#### **104 Consideration of applications**

- (1) When considering an application for a resource consent and any submissions received, the consent authority must, subject to [Part 2](#), have regard to—
  - (a) any actual and potential effects on the environment of allowing the activity; and
  - (b) any relevant provisions of—
    - (i) a national environmental standard;
    - (ii) other regulations;
    - (iii) a national policy statement;
    - (iv) a New Zealand coastal policy statement;
    - (v) a regional policy statement or proposed regional policy statement;
    - (vi) a plan or proposed plan; and

#### **Effluent System Details**

- Confirmation of the proposed pond volume as multiple figures have been used in the application, is this 3,060 or 5,060 cubic metres?

The proposed pond volume is 5,565. The details in section 6 that refer to 3,060 were incorrect from a previous version of this application drafted in 2016.

- An explanation for how the effluent system will operate in the interim before the new effluent storage is constructed and is operational. What contingency measures are in place to mitigate any interim effects?

The farm has about 100m<sup>3</sup> of storage. This has been used for the past 10 years and with good management has provided reasonable level of control. Diligence will continue until the pond is completed prior to December 2017.

#### **Dairy Effluent Storage Calculator**

- An explanation for how the proposed storage volumes are consistent with deferred storage as determined by the Massey Pond Calculator.

The DESC states that the 90% probability storage volume is 5,522m<sup>3</sup>. The total proposed storage volume is 5,565m<sup>3</sup>.

The details in section 6 that refer to 3,060 were incorrect from a previous version of this application drafted in 2016.

- An explanation of the inputs into the Dairy Effluent Storage Calculator and adjustment to the inputs if required as follows:
  - The minimum effluent block has been put at 20ha rather than 60ha which is consistent with 8ha/100 cows as a best practice guide. Could you please provide a revised calculation which matches the value in Overseer needed to achieve 150kg/N/year or the best practice guide, or provide a suitable explanation for why 20ha is appropriate.

In the Massey pond calculator the low risk soil must be matched with an equal area of high risk soil and the balance of the discharge area is called “surplus area” in the report. All of the 200ha of discharge area is available all the time.

Please contact me if you have any questions.

Yours faithfully  
**Civil Tech Ltd**

Murray Gardyne  
Director

Your reference: App-20171209  
18 August 2017

The General Manager  
Environment Southland  
Private Bag 90116  
INVERCARGILL

Attention: Ms E Allan

Dear Emily

**Re: Potential public notification of South Dairy Ltd application - APP-20171302**

In our recent conversation you advised me that the South Dairy application will be publicly notified primarily because the Overseer modelling estimates that the total losses to the environment will increase by 315kg N each year under the details of the proposal.

While this is true, we believe that you have not taken into account the mitigation that has been proposed – to winter off the 599 cows for 84 days. Our calculations suggest that this will remove much more than the 315kg N each year, more than offsetting the expanded cow numbers.

This information was provided in the application in appendix 8 (also attached). The estimate of 3% attenuation (Houlbrooke & Monaghan, 2009) has been discussed and cited in previous correspondence. Our workings are summarised below:

Change in land use	Urinary N (kg/year)	Attenuated loss <sup>1</sup>	Notes
Remove stock from new block	-16,140 (decrease)	-484.2kg	Remove calves, heifers, and wintered cows
Expanded cow numbers	21,725 (increase)	651.75kg	Add 150 dairy cows, and 200 cows wintered for 23 days
Mitigation (Cows wintered off)	-22,038 (decrease)	-661.14kg	599 cows wintered off original platform
<b>Total</b>	<b>16,453 (decrease)</b>	<b>493.59kg</b>	

Because the overseer modelling did not include the mitigation, the 661kg N has not been taken into account, and this significant mitigation should be considered when making a decision on this application.

Please can you re-consider this, and we look forward to hearing your response.

<sup>1</sup> 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.

Yours faithfully  
Civil Tech Ltd

Murray Gardyne  
Director

## 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
<b>Totals</b>				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
<b>Totals</b>				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 (2016)	8	180	106*
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.



Our reference: APP-20171302  
Enquiries to: Emily Allan  
Email: Emily.Allan@es.govt.nz



29 November 2017

South Dairy Limited  
C/- D C & S M Alexander  
373 O'Shannessy Road  
RD 1  
Winton 9781

Dear Sir/Madam,

***Request for Further Information under Section 92(1) of the Resource Management Act 1991 - Application for a discharge permit, land use consents and a water permit.***

Regarding your recent application to expand your dairy farm at O'Shannessy Road (and other associated activities), I am writing to request further information to help prepare my assessment of your application for the hearings panel.

Could you please provide<sup>[1]</sup>, in accordance with Section 92(1) of the Resource Management Act:

- An Overseer budget for the past three years to represent a current farm scenario (i.e. 2014/15, 2015/16 and 2016/17 years).

This question arose since I have reviewed the further information (14 August 2017) and the amended overseer budgets (9 and 22 November) that you provided.

Part of my assessment of your proposal requires a comparison of the nutrient losses from the current farming scenario with those forecast after expanding the farm. For this assessment to be meaningful it needs to include accurate modelling of the "current" and "future" states. However, these scenarios can vary significantly depending on the time period chosen to represent them and model them.

For me to fully understand the current situation as a baseline, an Overseer budget for the past three years of nutrient losses would be the most useful.

This is the second s92(1) request for further information this application, so under Section 88C of the RMA this request does not exclude time from the application processing (the application is not on hold). I would appreciate if you confirm by **Tuesday 5 December 2017** if you intend to respond to this request. Please do also note that the Council may decline the application if it has inadequate information to determine it.

Please contact me if you have any questions regarding this request.

Yours sincerely



Emily Allan  
**Consents Officer**

---

[1] Under Section 92(1) of the Resource Management Act 1991 (RMA) the Council may, at any time before the hearing of an application, or if no hearing is to be held, before the decision to grant or refuse the application is made, request in writing that the applicant provide further information relating to the application.

Our reference: APP-20171302  
Enquiries to: Emily Allan  
Email: Emily.Allan@es.govt.nz



29 November 2017

Civil Tech Limited  
PO Box 1558  
Invercargill 9840

Dear Murray,

***Request for Further Information under Section 92(1) of the Resource Management Act 1991 - Application for a discharge permit, land use consents and a water permit.***

Regarding your recent application to expand your dairy farm at O'Shannessy Road (and other associated activities), I am writing to request further information to help prepare my assessment of your application for the hearings panel.

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For me to fully understand the current situation as a baseline, an Overseer budget for the past three years of nutrient losses would be the most useful.

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Please contact me if you have any questions regarding this request.

Yours sincerely



Emily Allan  
**Consents Officer**

---

[1] Under Section 92(1) of the Resource Management Act 1991 (RMA) the Council may, at any time before the hearing of an application, or if no hearing is to be held, before the decision to grant or refuse the application is made, request in writing that the applicant provide further information relating to the application.

## Emily Allan

---

**From:** alexander.farms01@gmail.com  
**Sent:** Thursday, 21 December 2017 4:25 PM  
**To:** Emily Allan  
**Subject:** Fw: XML for emily from ES  
**Attachments:** Ovr-NB 2014 -17 Average DSN 31827 {Copy} - copy 2.xml

**Categories:** Consent tasks

Hi Emily

Please find attached the nutrient budget report in XML format that has been forwarded to me from Mark today.

Mark is intending to complete his report and have this to us tomorrow. I have difficulty understanding the current report in its XML format however Mark tells me that the N losses are at 47kgN/ha/yr. He has prepared this to our consented numbers of 599 cows and has adjusted some of the feed figures to allow for the increased numbers compared to what we actually farmed. I will get a better understanding of this tomorrow when I view the completed more user friendly version and will forward you any further information that I have after viewing this.

I will forward the completed version when I receive it tomorrow. If you have any further questions please do not hesitate to call Mark or myself.

Regards

Dean Alexander

**From:** Mark Crawford  
**Sent:** Thursday, December 21, 2017 2:39 PM  
**To:** alexander.farms01@gmail.com  
**Subject:** XML for emily from ES

As discussed

Mark

  
**ravensdown**

---

**Mark Crawford**  
Snr Farm Environmental Consult



p. +6434712075 | m. +64 21 900 407 | e. [Mark.Crawford@ravensdown.co.nz](mailto:Mark.Crawford@ravensdown.co.nz)  
[ravensdown.co.nz](http://ravensdown.co.nz) | [Twitter](#) | [LinkedIn](#) | [Facebook](#)

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## Emily Allan

---

**From:** alexander.farms01@gmail.com  
**Sent:** Friday, 22 December 2017 4:56 PM  
**To:** Emily Allan  
**Subject:** Fw: XML for emily from ES  
**Attachments:** FINAL Farm Supplementary Scenario Plan (2) Yr avge -SOUTH DAIRY LTD dec17docx.pdf

**Categories:** Consent tasks

Hi Emily

A copy of the final nutrient budget scenario supplied by Mark. It has only just arrived, I have had time to have a very quick look at and appears to be as I requested. I will get a chance tomorrow to have a better look at this and I will send a any notes or thoughts after this so you will have these when you return after the holiday period.

Thanks

Dean

**From:** Mark Crawford  
**Sent:** Friday, December 22, 2017 2:42 PM  
**To:** alexander.farms01@gmail.com  
**Subject:** RE: XML for emily from ES

Please find attached the report as requested with changes of the averaged years as asked for

Regards

Mark

  
**ravensdown**

---

  
**Mark Crawford**  
Snr Farm Environmental Consult



---

**p.** +6434712075 | **m.** +64 21 900 407 | **e.** [Mark.Crawford@ravensdown.co.nz](mailto:Mark.Crawford@ravensdown.co.nz)  
[ravensdown.co.nz](http://ravensdown.co.nz) | [Twitter](#) | [LinkedIn](#) | [Facebook](#)

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**From:** alexander.farms01@gmail.com [<mailto:alexander.farms01@gmail.com>]  
**Sent:** Thursday, 21 December 2017 4:51 p.m.

**To:** Mark Crawford <Mark.Crawford@ravensdown.co.nz>  
**Subject:** Re: XML for emily from ES

Please see attached consultancy agreement.

Thanks

Suzanne

**From:** Mark Crawford  
**Sent:** Thursday, December 21, 2017 2:39 PM  
**To:** alexander.farms01@gmail.com  
**Subject:** XML for emily from ES

As discussed

Mark

  
**ravensdown**



---

**Mark Crawford**  
Snr Farm Environmental Consult



---

p. +6434712075 | m. +64 21 900 407 | e. [Mark.Crawford@ravensdown.co.nz](mailto:Mark.Crawford@ravensdown.co.nz)  
[ravensdown.co.nz](http://ravensdown.co.nz) | [Twitter](#) | [LinkedIn](#) | [Facebook](#)

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Click [here](#) to report this email as spam.

## Emily Allan

---

**From:** alexander.farms01@gmail.com  
**Sent:** Tuesday, 19 December 2017 2:37 PM  
**To:** Emily Allan  
**Subject:** App number 20171302

Hi Emily

I am writing following your requests for further information after our discussions late last week.

I am confirming that we want you to continue processing of the above application. Can you please attempt to get our required hearing date ASAP and notify us of when this will be. It would be appreciated if this could be before the end of February as someone involved in helping us with the Hearing process is going to be out of the country from early March for 2 months.

We are withdrawing Murray Gardyne from Civil Tech as our consultant for the remainder of this process. Can you please forward any further correspondence directly to us at this email address.

It should also be noted that we are now applying for the consent of our effluent pond in retrospect as this has been completed and currently in use as you would have noticed at your recent on farm visit.

You mentioned that you still require a copy of the PS4 from the chartered professional engineer regarding the signing off of the new pond. I will attempt to get this to you in the next few days.

We have been advised that we can expect the revised nutrient budgets before Xmas. We will be reviewing these as soon as we receive them and will forward them to you as soon as we are satisfied with their content. We can either email these to you or would be happy to bring them to you in person at a suitable time so we may be able to sit and go over any changes in them with you.

We will be proceeding with removing the existing clay pond from the old effluent system as per your recommendations at your site visit.

Thanks again for your assistance over the past couple of weeks as we now feel that we have some direction as to the path forward and are looking forward to getting the issues with this consent resolved so we can move ahead with confidence.

If you require any further information please do not hesitate to give a call or email me at the above address.

Yours Sincerely

Dean Alexander  
South Dairy Limited  
0274 066 878

## Emily Allan

---

**From:** alexander.farms01@gmail.com  
**Sent:** Thursday, 25 January 2018 1:24 PM  
**To:** Emily Allan  
**Subject:** irrigator type

Hi Emily

As requested I am confirming that we will be using 2 Williams Magnum travelling irrigators for application of the dairy shed effluent. Not a Cobra rain gun as per the consent application.

Regards

Dean Alexander

# Technical Comment



**environment  
SOUTHLAND**

*Te Taiaro Tonga*

Environment Southland is the brand  
name of Southland Regional Council

Cnr North Rd & Price St, Private Bag 90116  
Invercargill New Zealand  
Phone 03 211 5115 Fax 03 211 5252  
Tollfree (Southland only) 0800 76 88 45  
Email [service@es.govt.nz](mailto:service@es.govt.nz)  
Web site [www.es.govt.nz](http://www.es.govt.nz)

## Memorandum

*For Your Information*

**To:** Emily Allan

**From:** Colin Young  
Technical Services Engineer

**Date:** Monday, 12 June 2017

**File Reference:** South Dairy Ltd APP-20171302

**Subject:** *Installation of Effluent Pond*

### *Message:*

I have inspected the documentation for a consent to install a sludge bed and synthetic lined effluent storage pond for South Dairy Ltd and I am satisfied that the plans and specification meets the criteria of IPENZ Practice Note 21 (Version 2 March 2013) Farm Dairy Effluent Pond Design and Construction.

I would recommend that gas venting be installed with the synthetic liner.

Colin Young  
Technical Services Engineer

*for now and your future*



# **Topoclimate Information Sheets**

This Information Sheet describes the *typical average properties* of the specified soil. It is essentially a summary of information obtained from one or more profiles of this soil that were examined and described during the Topoclimate survey or previous surveys. It has been prepared in good faith by trained staff within time and budgetary limits. However, no responsibility or liability can be taken for the accuracy of the information and interpretations. Advice should be sought from soil and landuse experts before making landuse decisions on individual farms and paddocks. The characteristics of the soil at a specific location may differ in some details from those described here.  
No warranties are expressed or implied unless stated.

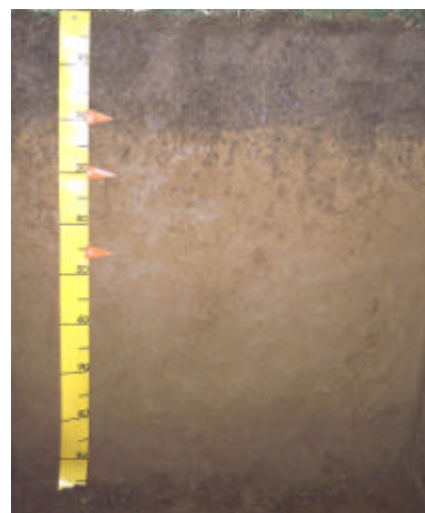
## Soil name: **Edendale**

### 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.

### 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.



*Edendale profile*

### 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
<b>Structural compaction</b>	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.
<b>Nutrient leaching</b>	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.
<b>Topsoil erodibility by water</b>	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.
<b>Organic matter loss</b>	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).
<b>Waterlogging</b>	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 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.

### 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.

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This Information Sheet describes the *typical average properties* of the specified soil. It is essentially a summary of information obtained from one or more profiles of this soil that were examined and described during the Topoclimate survey or previous surveys. It has been prepared in good faith by trained staff within time and budgetary limits. However, no responsibility or liability can be taken for the accuracy of the information and interpretations. Advice should be sought from soil and landuse experts before making landuse decisions on individual farms and paddocks. The characteristics of the soil at a specific location may differ in some details from those described here.  
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## 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.

### 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.



*Northope profile*

### 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
<b>Structural compaction</b>	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.
<b>Nutrient leaching</b>	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.
<b>Topsoil erodibility by water</b>	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.
<b>Organic matter loss</b>	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).
<b>Waterlogging</b>	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 (Northhope undulating deep)

### NhU2 (Northhope 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.

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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
<b>Structural compaction</b>	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.
<b>Nutrient leaching</b>	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.
<b>Topsoil erodibility by water</b>	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.
<b>Organic matter loss</b>	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)
<b>Waterlogging</b>	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.