11 January 2017

Environment Southland

12 JAN 2017

LANDPRO
Make the most of your land

Environment Southland
Private Bag 90116
Invercargill 9348

Our Ref: S14303

Attn: Consents Manager

To whom it may concern,

RE: Dairy Conversion and Associated Activities – Schrader Mains Limited

Please find enclosed an application on behalf Schrader Mains Limited, to convert their property at 514 Rimu-Seaward-Downs Road, Rimu Seward Downs, to dairying. A suite of resource consents are sought including:

- *Land use consent to convert land to dairy;*
- *Land use consent for dairy farming;*
- *Land use consent for pond construction;*
- *Land use consent for bore construction*
- *Water Permit to abstract up to 36,720 litres of groundwater per day for stock drinking and dairy shed use;*
- *Discharge Permit to discharge farm dairy effluent to land from up to 306 dairy cows;*

The assessment of effects as contained within the following report found that the effects on the surrounding environment are considered to be no more than minor and consistent with Council Plans and Policies, if the proposed activities were to occur as outlined in the consent application. A Schedule 4 of the Resource Management Act 1991 (RMA) checklist is enclosed stating the Section of the Assessment of Effects Report where the relevant information can be found. The correct information is contained within the application as prescribed by the relevant regulations, and as a requirement under Schedule 4 of the RMA.

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0800 023 318
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The deposit fee of $1,800, which is the appropriate processing fee for the suite of consents applied for has been paid online by the applicant.

Should you have any questions of a planning nature please do not hesitate to contact myself in our Cromwell office on (03) 445 9905.

Yours sincerely,

Zoe McCormack

Resource Management Planner

2 McNulty Road | PO Box 302 |Cromwell 9342
P 03 445 9905
zoe@landpro.co.nz | www.landpro.co.nz

LANDPRO	**RESOURCE MANAGEMENT FORMS**	*Section:* RF06
		No. of Pages: 4
RESOURCE CONSENT APPLICATION SCHEDULE 4 CHECKLIST		*Issue:* 1
		Date: 3 December 2015

Job No: S14303 ***Date:*** 9/01/2016

Client Name: Schrader Mains Limited.

1. Information must be specified in sufficient detail

Any information required by this schedule, including an assessment under clause 2(1)(f) or (g), must be specified in sufficient detail to satisfy the purpose for which it is required.

2. Information required in all applications

1. An application for a resource consent for an activity (the activity) must include the following:

	Checklist	Yes	N/A	Report Section	Comments
a)	A description of the activity	☑	☐	3	
b)	A description of the site at which the activity is to occur	☑	☐	2	
c)	The full name and address of each owner of occupier of the site	☑	☐	1.2	
d)	A description of any other activities that are part of the proposal to which the application relates	☑	☐	3	
e)	A description of any other resource consents required for the proposal to which the application relates	☑	☐	3	
f)	An assessment of the activity against the matters set out in Part 2	☑	☐	7.1	
g)	An assessment of the activity against any relevant provisions of a document referred to in section 104(1)(b)	☑	☐	7.2	

2. The assessment under subclause (1)(g) must include an assessment of the activity against:

	Checklist	Yes	N/A	Report Section	Comments
a)	Any relevant objectives, policies, or rules in a document; and	☑	☐	7.2	
b)	Any relevant requirements, conditions, or permissions in any rules in a document; and	☑	☐	7.2	
c)	Any other relevant requirements in a document (for example, in a national environmental standard or other regulations.	☑	☐	7.2	

3. Additional information required in some applications

An application must also include any of the following that apply:

	Checklist	Yes	N/A	Report Section	Comments
a)	If any permitted activity is part of the proposal to which the application relates, a description of the permitted activity that demonstrates that it complies with the requirements, conditions, and permissions for the permitted activity (so that a resource consent is not required for that activity under section 87A(1):	☑	☐	4.1	
b)	If the application is affected by section 124 or 165ZH(1)(c) (which relate to existing resource consents), an assessment of the value of the investment of the existing consent holder (for the purposes of section 104(2A)):	☐	☑		
c)	If the activity is to occur in an area within the scope of a planning document prepared by a customary marine title group under section 85 of the Marine and Coastal Area (Takutai Moana) Act 2011, an assessment of the activity against any resource management matters set out in that planning document (for the purposes of section 104(2B)).	☐	☑		

4. Additional information required in an application for subdivision consent

An application for a subdivision consent must also include information that adequately defines the following:

	Checklist	Yes	N/A	Report Section	Comments
a)	The position of all new boundaries	☐	☑		
b)	The areas of all new allotments, unless the subdivision involves a cross lease, company lease, or unit plan:	☐	☑		
c)	The locations and areas of new reserves to be created, including any esplanade reserves and esplanade strips:	☐	☑		
d)	The locations and areas of any existing esplanade reserves, esplanade strips, and access strips:	☐	☑		
e)	The locations and areas of any part of the bed of a river or lake to be vested in a territorial authority under section 237A:	☐	☑		
f)	The locations and areas of any land within the coastal marine area (which is to become part of the common marine and coastal area under section 237A):	☐	☑		
g)	The locations and areas of land to be set aside as new roads.	☐	☑		

5. Additional information required in application for reclamation

An application for a resource consent for reclamation must also include information to show the area to be reclaimed, including the following:

	Checklist	Yes	N/A	Report Section	Comments
a)	The location of the area:	☐	☑		
b)	If practicable, the position of all new boundaries:	☐	☑		
c)	Any part of the area to be set aside as an esplanade reserve or esplanade strip.	☐	☑		

6. Information required in assessment of environmental effects

1. An assessment of the activity's effects on the environment must include the following information:

	Checklist	Yes	N/A	Report Section	Comments
a)	If it is likely that the activity will result in any significant adverse effect on the environment, a description of any possible alternative locations or methods for undertaking the activity:	☑	☐	6.6	
b)	An assessment of the actual or potential effect on the environment of the activity:	☑	☐	6	
c)	If the activity includes the use of hazardous substances and installations, an assessment of any risks to the environment that are likely to arise from such use:	☐	☑		
d)	If the activity includes the discharge of any contaminant, a description of -: i. The nature of the discharge and the sensitivity of the receiving environment to adverse effects; and ii. Any possible alternative methods of discharge, including discharge into any other receiving environment:	☑	☐	6.2 + 6.6	
e)	A description of the mitigation measures (including safeguards and contingency plans where relevant) to be undertaken to help prevent or reduce the actual or potential effect:	☑	☐	Attachment G + 6.8	
f)	Identification of the persons affected by the activity, any consultation undertaken, and any response to the views of any person consulted:	☑	☐	5	
g)	If the scale and significance of the activity's effects are such that monitoring is required, a description of how and by whom the effects will be monitored if the activity is approved:	☑	☐	Attachment G. + 6.8	
h)	If the activity will, or is likely to, have adverse effects that are more than minor on the exercise of a protected customary right, a description of possible alternative locations or methods for the exercise of the activity (unless written approval for the activity is given by the protected customary rights group).	☐	☑		

2. A requirement to include information in the assessment of environmental effects is subject to the provisions of any policy statement or plan.

7. Matters that must be addressed by assessment of environment effects

1. An assessment of the activity's effects on the environment must address the following matters:

	Checklist	**Yes**	**N/A**	**Report Section**	**Comments**
a)	Any effect on those in the neighbourhood and, where relevant, the wider community, including any social, economic, or cultural effects:	☑	☐	6·7	
b)	Any physical effect on the locality, including any landscape an visual effects:	☑	☐	6·7	
c)	Any effect on ecosystems, including effects on plants or animals and any physical disturbance of habitats in the vicinity:	☑	☐	6·7	
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:	☑	☐	6·7	
e)	Any discharge of contaminants into the environment, including any unreasonable emission of noise, and options for the treatment and disposal of contaminants:	☑	☐	6·7	
f)	Any risk to the neighbourhood, the wider community, or the environment through natural hazards or the use hazardous substances or hazardous installations.	☑	☐	6·7.	

2. The requirement to address a matter in the assessment of environmental effects is subject to the provisions of any policy statement or plan.

LANDPRO
Make the most of your land

Schrader Mains Limited

Resource Consent Applications to Establish a New Dairy Farm

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11 January 2017

QUALITY INFORMATION

Reference: S14303

Document: Assessment of Environmental Effects – Dairy Conversion

Date: 11 January 2017

Prepared by: Zoe McCormack

Reviewed by: Kate Scott

Version Number: A

Client Review: Hank and Sandra Schrader

CONTENTS

ATTACHMENTS

Attachment A – Certificates of Title
Attachment B – Conversion Environment Plan
Attachment C – Farm Environmental Management Plan
Attachment D – Technical Assessment
Attachment E – Dairy Effluent Pond Design Report
Attachment F – Affected Party Approvals
Attachment G – Draft Conditions of Consent

1. INTRODUCTION

1.1 Overview

The applicant, Schrader Mains Limited wishes to convert 109.52 hectares (ha) of their property (with a maximum 103 ha effective area) to dairy with a proposed maximum herd size of 306 cows peak milked at the property located at 514 Rimu-Seaward Downs Road, Rimu-Seaward Downs. To be able to do so, new resource consents are required from Environment Southland (ES) to convert land to dairy, for the ongoing use of land for dairy farming, to take groundwater for dairy shed and stock drinking purposes and to discharge farm dairy effluent (FDE) to land via low rate irrigation. Table 1 summarises these activities.

Table 1: Summary of Relevant Matters

<table>
<tr><th colspan="5">Property details</th></tr>
<tr><td>Location</td><td colspan="4">514 Rimu Seaward Downs Road, Rimu-Seaward Down</td></tr>
<tr><td>Catchment</td><td colspan="4">Waituna Creek</td></tr>
<tr><td>Area</td><td colspan="4">Total Property Area: 109.52 ha Conversion Area: 109.52 ha Effective Area: 103</td></tr>
<tr><td>Legal description</td><td colspan="4">Section 7, Section 49, Block II Oteramika Hundred; Lot 1 Deposited Plan 12478; Part Sections 5 - 6 Block II Oteramika Hundred (Certificate of Titles SL9C/678 & SL9C/679 – Contained within Attachment A).</td></tr>
<tr><td rowspan="4">Soils</td><td rowspan="2">Soil Type</td><td colspan="3">Vulnerability Factors</td></tr>
<tr><td>Structural Compaction</td><td>Nutrient Leaching</td><td>Waterlogging</td></tr>
<tr><td>Dacre</td><td>Moderate</td><td>Slight</td><td>Severe</td></tr>
<tr><td>Woodlands</td><td>Moderate</td><td>Slight</td><td>Moderate</td></tr>
<tr><td>FDE land classification</td><td colspan="4">Category B (Impeded drainage or low infiltration rate) 85% of Conversion area.
Category C (Sloping land) 15% of Conversion Area.</td></tr>
<tr><td>FDE risk - groundwater</td><td colspan="4">Moderate</td></tr>
<tr><td>FDE risk – surface water</td><td colspan="4">Moderate to High (either side of water way)</td></tr>
<tr><td>Groundwater Nitrates</td><td colspan="4">Pristine, pre-European Minor to Moderate Land Use Impacts (0.01 – 1.0 mg/L)</td></tr>
<tr><td>Physiographic Zones</td><td colspan="4">Gleyed (100%)</td></tr>
<tr><th colspan="5">Land Use Consent for the conversion and ongoing use of Land Dairy Farming Details:</th></tr>
<tr><td>Versatility Rating</td><td colspan="4">10</td></tr>
<tr><td>Conversion Environment Plan</td><td colspan="4">Category 1</td></tr>
<tr><td>OVERSEER® predicted losses</td><td colspan="4">25 kg N/ha/year and 0.7 kg P/ha/year</td></tr>
<tr><td>Conversion Area</td><td colspan="4">109.52 ha</td></tr>
<tr><td>Stock</td><td colspan="4">306 milking cows</td></tr>
<tr><td>Wintering (1 June – 31 July)</td><td colspan="4">All stock wintered off farm</td></tr>
<tr><td>Nutrient Budget</td><td>Current</td><td colspan="2">Proposed</td><td>Difference</td></tr>
<tr><td>N Loss to water (kg/ha/yr)</td><td>40</td><td colspan="2">25</td><td>-15 kg/ha/year</td></tr>
<tr><td>P Loss to water (kg/ha/yr)</td><td>0.4</td><td colspan="2">0.7</td><td>+0.2kg/ha/year</td></tr>
<tr><td>Mitigations proposed</td><td colspan="4">As contained within the attached Farm Management Plan and proposed conditions of consent</td></tr>
<tr><th colspan="5">Water Permit to Abstract Groundwater details:</th></tr>
<tr><td>Source (zone)</td><td colspan="4">Awarua Groundwater / Waihopai Groundwater Management Zone</td></tr>
<tr><td>Location (NZTM 2000)</td><td colspan="4">1264502E 4851627N & 1264616E 4851107 N</td></tr>
<tr><td>Aquifer type</td><td colspan="4">Lowland</td></tr>
<tr><td>Storage on site</td><td colspan="4">Water tanks at the Dairy Shed</td></tr>
<tr><td>Daily volume (l)</td><td colspan="4">36,720</td></tr>
</table>

Rate of take (l/s)	2
Rate (l/cow/day)	120
Proposed Annual Volume (m^3/year)	11,120
Discretionary/Primary Allocation (m^3/year)	Waihopai Groundwater Management Zone = 54,100,000 Awarua Groundwater Management Zone = 32,290,000
Current allocation (m^3/year and % of discretionary allocation)	Waihopai Groundwater Management Zone = 2,875,166 (5.3 %) Awarua Groundwater Management Zone = not applicable
Discharge Permit to Discharge Farm Dairy Effluent to Land details:	
Cow numbers	306
Stocking rate (cows/ha)	2.97
Disposal area (ha)	26 minimum; 96 maximum
Irrigator proposed	Low rate irrigation
Storage available (m^3)	930 m^3
Monitoring proposed	In accordance with conditions of consent and Effluent Management Sections of attached Management Plans
Land Use Consent to construct effluent storage details:	
Pond Designer	RD Agritech Limited
Contractor	TBC
Drawings from engineer supplied	RD Agritech Limited
Method of sealing pond	Synthetic
Land Use Consent to construct a bore details:	
Legal description	Lot 1 DP 12478
Map reference (NZTM 2000)	1264616E 4851107 N
Nearest bore	F46/0586 (200 metres)

1.2 The Applicant

The Applicant	Schrader Mains Limited C/- Hank and Sandra Schrader 514 Rimu Seaward Downs Road RD1, Invercargill (03) 2395 528 schrader@woosh.co.nz
Address for Service	C/- Landpro Limited PO Box 302 Cromwell 9342

1.3 Purpose of Documentation

This report provides the relevant information as required by Schedule 4 of the Resource Management Act 1991 (RMA) and relevant Regional Planning codes in addition to the applications made in the prescribed Council forms.

1.4 Site Location and Description

The property subject to this application, totals 109.52 ha and is located at about NZTM2000: 1264607E 4851663N, within the upper reaches of the Waituna Catchment.

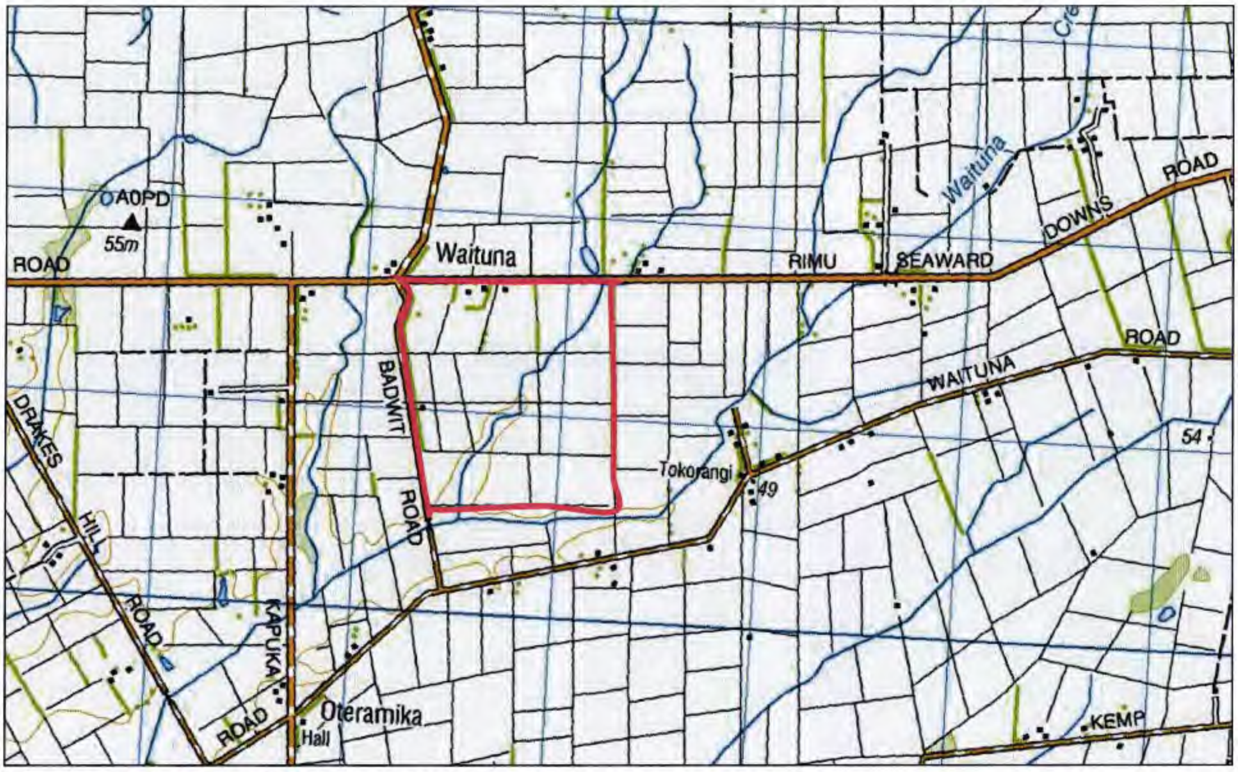

Figure 1: Site Location Plan [Source: LINZ Topo 50 Series]

1.5 Application History

An application and AEE were filed with Environment Southland in June 2015 in association with the proposal to convert the subject property to dairying. The application was publicly notified on 18 September 2015 with three submissions received. The applicant and submitters attended a pre-hearing meeting on 12 November 2015 during which proposed conditions were discussed. A hearing was subsequently held in Invercargill on 15 January 2016, and the decision to refuse the resource consent application APP-20158099 was passed on 8 March 2016. This decision was appealed to the Environment Court (ENV-2016-CHC-014).

On June 3 2016 Environment Southland notified the proposed Southland Water and Land Plan (PSWLP) and subsequent legal advice from Environment Southlands lawyer revealed that the applicant would be unable to operate under any consents issued because of any successful appeal of the decision on APP-20158099[1] without first obtaining resource consents for the proposed activities pursuant to the relevant rules of the PSWLP.

This application addresses the consenting requirements under both the Operative RWPS and the Proposed SWLP.

2. DESCRIPTION OF THE EXISTING ENVIRONMENT

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[1] Legal Advice provided by MR B Slowley, 23 June 2016.

2.1 Topography and Land Use

The subject site is described as generally flat to undulating with a ryegrass pasture coverage with up to 20 ha of kale. There are some exotic trees planted along the property boundaries and throughout internal paddock boundaries. The property is approximately 80 meters (m) above mean sea level.

The property has been run as a dairy support (including young stock and winter grazing) unit by the applicant for the past 6 years, although prior to that the property was leased by the applicant for 11 years and run as a beef grazing block. The surrounding land is entirely agricultural in use, including beef and dairy farming, with some smaller lifestyle blocks.

Conventional farming practices are applied, with all current farming activities permitted via the relevant regional and district plans (further consideration of permitted activities is given in Section 4.1 of this report).

2.2 Physiographic

The whole property is located within the Gleyed Zone (no variant) as determined by the ES GIS Database, Beacon. The expected contaminant pathways are summarised below for the Gleyed physiographic zone.

- **Gleyed**

  The Gleyed physiographic zone comprises predominately flat to undulating land that occurs between major river systems where soils are fine textured and poorly drained. This zone is characterised by soils which have distinctive redoxomphoric features such as mottling and gleying (resulting from extending periods of soil waterlogging). Soils in this zone have an ability to remove nitrogen from water to the atmosphere via denitrification, however this process can be bypassed when contaminants are flushed to nearby surface water bodies via artificial drains and overland flow following heavy or sustained rainfall events[2].

2.3 Soils

Topoclimate South have mapped the soils on the property consisting of a variety of soils with Woodlands and Dacre soils noted as the dominant soil type. These dominant soil types are summarised below:

- **Dacre soils**

  Dacre soils comprises approximately 16 % of the soils found on the property, and are mainly found around the waterways. These soils are moderately deep to deep, poorly drained, and have silty textures. They are formed into fine alluvium from rewashed loess.

- **Woodland Soils**

  Woodlands soils, comprises approximately 84 % of the total property area, are imperfectly drained, have a deep rooting depth, high water holding capacity and silt loam textures. They are formed in deep wind-deposited loess derived from greywacke and schist rocks.

The soil vulnerability factors and risk to water quality have been summarised in Table 1 above, and include moderate to severe potential for waterlogging. The property has a network of existing tile drains,

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[2] Environment Southland Physiographic Zone Fact Sheets (2015).

mitigating the potential for waterlogging. Further details of the soil types found within the property can be found in the attached Technical Assessment (Attachment D).

With regards to the soil risk associated with effluent application, the minimum management criteria for a land applied effluent system to achieve are presented in Table 2 below, consistent with Policy 24 of the RWPS. Category B and C soils are identified within the 96-ha proposed effluent disposal area.

Table 2: Minimum management criteria for a land applied effluent system to achieve

	Category B	Category C
Soil and Landscape Feature	*Impeded drainage or low infiltration rate*	*Sloping land (>7°)*
Application depth (mm)	*< Soil water deficit*	*< Soil water deficit*
Instantaneous application rate (mm/hour)	*N/A**	*< Soil infiltration rate*
Average application rate (mm/hr)	*< Soil infiltration rate*	*< Soil infiltration rate*
Storage requirement	*Apply only when soil water deficit exists*	*Apply only when soil water deficit exists*
Maximum N load	*150 kg N/ha/yr*	*150 kg N/ha/yr*

**Not an essential criterion, however level of risk and management is lowered if using low application rates*

2.4 Climate

In terms of climate, the Waituna catchment is described as cool-temperate, with an assumed annual rainfall of approximately 1,152 mm, based on the OVERSEER® Climate station tool. The property has a mean annual temperature of 10.1 degrees Celsius. Highest rainfall within the catchment occurs during summer and autumn and the lowest totals during winter and spring.

2.5 Water Resources

The farm is located in the Waituna Creek Surface Water Management Zone. The locations of all waterways are shown on the attached scheme plans contained within the attached Conversion Environment Plan (CEP) and the Farm Management Plan (FMP) (Attachments B and C).

All permanent flowing waterways on the property are fenced with grass buffers and existing extensive plantings. The CEP appended contains some generalised management practices relating to riparian margins on the farm,

The key receiving environments associated with the property are:

- McMillian Creek and some of its un-named tributaries which flow in a south-westerly direction through the applicant's property;
- Waituna Creek, which is the receiving water body from McMillian Creek at a point downstream of the applicant's property;
- Groundwater underneath the property which is part of the Awarua groundwater management zone (previously mapped as the Waihopai groundwater management zone). This groundwater zone is assumed to predominantly discharge into the Waituna Creek;
- Waituna Lagoon (located approximately 16 km downstream of the site), which is included as a sensitive water body in Appendix Q of the PSWLP.

2.5.1 Values and Objectives

The Regional Water Plan for Southland 2010 (RWPS), Proposed Southland Water and Land Plan (PSWLP) and the Regional Coastal Plan for Southland, 2013 (RCP) describe the values and objectives for freshwater and coastal water bodies in the Southland Region, respectively. These values establish the desired condition of the receiving environments and underpin the water quality standards used to assess the impact of land use activities. Under the RWPS the waterbodies on the property are classified as Lowland hard bed waterways, while the PSWLP does not provide classification. Table 3 below provides a summary of the key objectives of both the RWPS and PSWLP in relation to surface water values.

Table 3: Summary of regional plans surface water values for streams within the property area

Regional Plan	Values specified
RWPS Objective 3	- *Bathing in those sites where bathing is popular;* - *Trout where present, otherwise native fish;* - *Stock drinking water;* - *Ngāi Tahu cultural values, including mahinga kai;* - *Natural character including aesthetics*
PSWLP Objectives 3, 6, 7, 9, 11	- *The mauri (inherent health) of waterbodies provide for te hauora o te tangta (health of the people), te hauora o te taiao (health of the environment) and te hauora o te wai (health of the waterbody)* - *There is no reduction in the quality of freshwater and water in estuaries and coastal lagoons* - *Avoid and reduce over-allocation (quality and quantity) of freshwater* - *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 wellbeing.* - *Water is allocated and used efficiently*

Those relevant values as relate to the RCP are contained within Section 3 of the attached Technical Assessment (Attachment D).

2.5.2 Receiving Environments Sensitivity, Susceptibility and Existing Water Quality

A comprehensive description and assessment of the receiving environments sensitivity, susceptibility and existing water quality is provided in the attached Water Quality Assessment prepared by Karen Wilson, Landpro Ltd (Attachment D). A summary of these matters is given below.

Waituna Lagoon

The Waituna Lagoon is a relatively large, brackish, intermittently closed and open coastal lake and lagoon (ICOLL) that is located approximately 10 kilometres east of Invercargill. The lagoon is fed by three freshwater streams, the largest of which is the Waituna Creek, and drains to the sea through an artificially managed opening. The Waituna Lagoon is listed as a Sensitive Waterbody in Appendix Q of the PSWLP, and forms a unique highly valued feature of the Southland environment[3]. The Lagoon has international, national and regional significant, and is of cultural significance to the Ngai Tahu people and recognise through the Ngai Tahu Claims Settlement Act 1998.

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[3] Section 4.1, Technical Assessment, K. Wilson, 2016, (Attachment D).

The Waituna Lagoon sits at the bottom of a small coastal catchment, dominated by agricultural land uses. the lagoon is artificially opened to the sea to prevent flooding and to improve catchment drainage.

The quality of the Waituna Lagoon environment, including the nutrient loading, and macrophyte communities are influenced by the opening and closing regime of the lagoon.

Environment Southland have indicated they are about to undertake a water quality update for the Waituna Lagoon, however this report is currently unavailable (K, Robertson *pers. coms.* 2016). Monitoring of macrophytes in the lagoon is undertaken by the Department of Conservation and the results from the 2015/16 summer show "*an average lagoon-wide total macrophyte cover of 58% and a Ruppia spp. lagoon-wide cover of 57%. This was almost a doubling of the summer 2015 survey lagoon-wide macrophyte cover of only 30%* (Sutherland *et al.*, 2016). This increase partially reflects macrophyte re-colonisation following de-vegetation associated with the lagoon being open (Sutherland *et al.*, 2016). Although the 2015/16 summer macrophyte cover is within the Lagoon Technical Group (2013) target of >30-60%, the report notes "*there was still a high abundance of algae, both filamentous and phytoplankton, in the lagoon. Managing both the lagoon opening regime and nutrient loads entering into the lagoon from freshwater inputs will assist with managing both the macrophyte beds and algal growth*" (Sutherland *et al.*, 2016).

Awarua Groundwater Management Zone

The property while previously classified as overlying the Waihopai Groundwater Management Zone under the RWPS, the property is now identified as being located within the Awarua Groundwater Management Zone (PSWLP). The hydrogeological setting under the property is described in Attachment D. According to Environment Southlands GIS programme, Beacon, the property is identified as having nitrate levels which reflect pristine, pre-European background levels (i.e. nitrate (as NO3N) between 0.01 – 0.4 mg/L) and minor to moderate land use impacts (i.e. nitrate between 1.0 – 3.5 mg/L), suggesting minimal impact of land use.

Overall, the attached Technical Assessment suggests that groundwater nitrate concentrations in the general area can become elevated, although the soils identified on the property show slight nitrate leaching risk only (which is consistent with the characteristics of the Gleyed physiographic zone. Denitrification potential within the soil zone is high, due to the predominately imperfectly to poorly drained soils. The amount of denitrification occurring depends on soil residence time.

Waituna Creek

The most recent available water quality monitoring data from the Waituna Creek catchment is presented in the attached Technical Assessment. The data shows that water quality generally in the Waituna Creek is relatively poor when compared to other SOE sites across New Zealand. In terms of nutrient concentrations, high nitrogen concentrations are found in the upper reaches of the catchment and high phosphorus concentrations and indicated in the lower reaches[4].

Nutrient loads to the Waituna Lagoon are not evenly distributed across the catchment, and further details of the spatial distribution of nutrient inputs across the catchment are outlined in the attached Technical Assessment (Attachment D).

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[4] Ibid.

3. DESCRIPTION OF PROPOSED ACTIVITIES

3.1 The Use of Land for New Dairying

Rule 17A of the RWPS requires that a Conversion Environmental Plan (CEP) be prepared for a property requiring resource consent to convert to dairy farming. According to Council prescribed application forms, the CEP must provide;

- *A description of the proposed conversion activities and which includes, but is not limited to:*
  - *A comprehensive description of the dairy farm that is to be established and how it is to be operated, including details of where stock will be wintered;*
  - *A Riparian Management Plan detailing any riparian planting programmes planned and the activities and practices that will be applied to riparian areas in order to exclude stock access;*

Rule 22 of the PSWLP requires that a FMP is prepared for a property where land prior to 30 May 2016 was not used for dairy farming. According to Rule 22 and Appendix N of the PSWLP a Management Plan must be:

> *"prepared and implemented in accordance with Appendix N including the mitigations relevant to the farming type being undertaken and relevant physiographic zone, and provided to Environment Southland upon request, or the farming activity and the landholding on which the activity is undertaken is listed on the Environment Southland Register of Independently Audited Self-Management Participants."*

At present, there is no Environment Southland Register of Independently Audited Self-Management Participants.

Summary information of the proposed dairying activity of the farm is provided as follows, with more detail on the operation of the dairy farm provided in the CEP, and FMP appended as Attachments B and C. It is considered that the FMP is the key document on the basis that this management plan will continue beyond the physical conversion of the land and will be utilised as the primary tool to manage the ongoing use of the land for dairying purposes.

Stock units

The total proposed conversion property area is 109.52 ha, with a 103-ha milking platform (reflecting the total effective area). A maximum of 306 cows are to be milked through a herringbone milking shed, resulting in a total stocking rate of 2.97 cows/ha. The typical milking season will be 1 August – 31 May with no winter milking proposed. All cows will be wintered off the milking platform.

Fertiliser and Nutrients

All fertiliser product is proposed to be applied consistent with the relevant permitted rules of the RWPS and PSWLP. All fertiliser decisions will be made in accordance with a regular soil testing program to provide for maintenance applications at the very least.

Supplementary feed will be used variably throughout the season and will be fed in the dairy shed, on selected blocks, and the proposed feed pad/standoff pad. In addition, an area of the property will be planted in Kale and rotated through all blocks. The current cropped area of 20 ha of Kale is used as winter feed and would be considered permitted in terms of the winter grazing rule in the PSWLP. The applicant intends to continue to operate within the permitted areas of winter grazing (under the PSWLP), with the general areas proposed to be cropped each year to be documented as part of the annual FMP review process. Under the proposed conversion scenario, it is proposed that a maximum of 2 hectares of crop will be utilised.

Wintering
All stock will be wintered off the milking platform (1 June – 31 July).

Riparian and laneways
All waterways on the property are fenced with vegetated riparian margin areas. Separation distances to grazing areas are approximately 2 – 3 m. The existing riparian management on farm is comprehensive, however as part of the overall conversion process some existing fence lines maybe altered to provide greater buffer areas around critical source areas.

The property already has constructed laneways throughout with only minor upgrades required to accommodate the movement of stock in and out of the proposed cowshed. The dairy shed will be accessed off Badwit Road. All laneways are cambered away from waterways, and further remedial works are proposed for the existing bridge crossing through the development of concrete nib walls to reduce the risk of direct discharge of effluent from the bridge to McMillan Creek.

3.2 Effluent Discharge

The proposed dairy herd of 306 cows will generate approximately 15,300 litres of effluent per day (based on an average of 50 litres per cow per day).

The management of the effluent discharge will be generally undertaken in accordance with the Effluent Management Section included within the attached FMP (Attachment C). The Effluent Management Section of the FMP, which includes operation and maintenance of the effluent system, would be exercised in accordance with any conditions attached to the Discharge Permit.

Pumps will have an automatic switch-off system as a contingency measure in the event of an effluent system failure. An anti-siphon device in the effluent pipeline will be installed to ensure siphoning of effluent does not occur when pumping has ceased.

3.2.1 Effluent Collection and Storage

Effluent from the shed and yard will drain via gravity to a stone trap. solids removed from the stone trap will be dried in a 4m x 3m concrete bunker which is to be constructed adjacent to the stone trap. A drain will be installed at the front of the bunker to direct any excess liquid back into the stone trap and allow the solids to dry, before solids are applied to land. Vehicle access will be provided for to the stone trap and solids bunker to enable this to be cleaned. Farm Dairy Effluent (FDE) will drain via gravity from the stone trap to a new 930 m^3 storage pond. FDE in the pond will be mixed prior to the discharge using a horizontal thrust stirrer.

The pond capacity has been calculated using the Massey University Dairy Effluent Storage Calculator (DESC) and the FDE Design Code of Practice. The DESC considers the receiving soils, climate data, number of cows, catchment areas and irrigation methods to determine the appropriate volume of storage. The recommended storage for the property has been calculated at 834 m^3. This calculation is based on a herd size of 320 cows to provide additional storage to allow greater flexibility for the applicant in terms of non-effluent discharge days of effluent from the maximum peak milking herd of 306 cows.

The pond has been appropriately sized to allow for effluent collected at a feed pad, to be stored in the effluent storage pond as well.

A copy of the effluent pond design report prepared by RD Agritech Limited, which includes the DESC Summary, is attached as Attachment E.

The proposal also includes the establishment of a concrete standoff pad/feed pad which will be used primarily on the shoulders of the season to hold stock off paddock where there is an increased potential for the discharge of contaminants, particularly via overland flow and artificial drainage to surface water[5] and soil damage.

3.2.2 Method of Discharge

Discharge of effluent will be undertaken year-round, utilising a low application rate Larral Smart Hydrant system. Discharge will occur on every available day until the nutrient limit of the soil or the maximum depth of application is reached. On days when the receiving soils are not suitable for effluent irrigation, the system will be inactive with daily FDE and stormwater stored in the storage tanks. The nearest Council soil moisture monitoring site will be used in conjunction with an on-farm hand held monitoring device, which is paddock specific, to determine whether soils are suitable for application of effluent in conjunction with visual inspection by the manager of the effluent system.

Policy 42 of the RWPS sets out criteria for minimum management of the application of effluent to land (Table 1 of Policy 42, RWPS). For soils, which are categorised as 'B', the instantaneous application rate is not considered an essential criterion, however the level of risk and management is lowered if using low application rates alongside application depths of equal to or less than soil water deficit. There is a small strip of soils either side of the McMillian Creek identified as Category "C", a 20 m buffer zone of application either side of the Creek will reduce the area of Category "C" land to receive effluent to a minimal portion of the total effluent area, however for completeness it is noted that the application rate over sloping land minimum criteria is that it is less than the soil infiltration rate.

Accounting for the minimum Council criteria, the irrigation system proposed is a low rate Larral Smart Hydrant system which will run for around 10 hours each day (a volume of 200m^3) with a maximum daily application depth of 10 mm, based on a 6 part Larral applying 2 mm depth per hour. Low rate systems are preferred by Environment Southland as having better environmental outcomes, incorporating low rate application of effluent over the soils with mixed contour and good drainage is suitable. This is consistent with Policy 42 of the RWPS.

Discharge using a slurry tanker is also proposed to ensure that the applicant can continue to dispose of effluent to land from the storage pond in accordance with a current consent should a breakdown in the installed irrigators occur. A slurry tanker will achieve low rate application and it is proposed that applied effluent does not exceed a depth of 7 mm for the tanker discharge only.

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[5] Evidence in Chief Ms K Wilson, Paragraph 43

The applicants will also spread sludge collected at the stone trap and dried on the drying pad to land, in accordance with the relevant permitted activity standards.

3.2.3 Disposal Land Area

The total area to be made available for effluent disposal is 93 ha. The following buffer zones will apply to the disposal area:

- 20 meters of any surface watercourse;
- 100 meters of any bore located on the property;
- 20 meters of any property boundary; and
- 200 meters of any residential dwelling other than residential dwellings on the property.

The areas which will be subject to effluent discharge are shown on the Effluent Disposal Plan contained in the attached Management Plans (Attachment B & C).

3.3 Taking and Use of Groundwater

It is proposed that a volume of 36,720 litres per day (36.72 m^3) will be abstracted from either one of two bores for dairy shed and stock drinking water purposes. The new bore is to be constructed on the property at or about NZTM 2000 1264616E 4851107N, while the existing bore is located at or about NZTM 2000 1264502E 4851627N. These daily volumes are permitted under the PSWLP.

Water storage will be available at the dairy shed, and comprise two 25,000 L tanks.

3.4 Effluent Pond Construction

The proposed effluent storage pond is to be designed and the construction overseen by RD Agritech Limited, the plans have been attached as Attachment E. The pond is to be lined with a synthetic liner and has been located on soils with low permeability. The effluent pond is to be sited within the vicinity of the dairy shed, as shown on the Farm Plan within Attachments B & C, with the following buffers observed:

- 50 metres from any surface water body, artificial watercourse or coastal marine area;
- 200 metres from any dwelling not on the same property;
- 50 metres from the boundary of any other property; and
- 100 metres from any water abstraction point.

Soil testing has been undertaken by RD Agritech Limited to ensure that the proposed site is appropriate for effluent storage.

The construction of the pond itself will be undertaken by contractors and overseen by RD Agritech Limited.

3.5 Bore Construction

The applicant wishes to construct a groundwater bore to abstract groundwater for stock and shed water in conjunction with an existing groundwater bore on the property, at or about NZTM 2000 1264616E 4851107N. The bore is to be located close to the proposed dairy shed.

The bore itself will be constructed in accordance with the NZS 4411:2001 Environment Standard for Drilling of Soil and Rock.

4. ACTIVITY CLASSIFICATION

The following resource consents are required under the Regional Water Plan for Southland (RPWS), Regional Land Effluent Application Plan (RELAP) and Proposed Southland Water and Land Plan (PSWLP).

Table 4: Consent Requirements

Consent	Plan	Rule	Activity Status
Land use consent to convert to dairying	RWPS	17A	*Discretionary*
Land use consent to use land for dairy farming	PSWLP	22 (a)	*Discretionary*
Discharge permit to discharge dairy shed and standoff/feed pad effluent to land	RWPS	50 (d)(i) and (ii)	*Restricted Discretionary*
	RELAP	5.4.6	*Discretionary*
	PSWLP	35 (c)	
Water permit to abstract groundwater for dairy operation	RWPS	23 (d)(ii)	*Discretionary*
	PSWLP	54	*Permitted*
Land use consent to construct effluent storage	RWPS	49 (a)	*Restricted Discretionary*
	PSWLP	32 (a)	*Discretionary*
Land use consent to construct a bore	RWPS	22	*Controlled*
	PSWLP	53	

Overall, the proposal is considered as a ***discretionary activity***. Council may grant or decline resource consents pursuant to Section 104B of the RMA and, if a decision to grant is made, may impose conditions it considers appropriate under Section 108 of the RMA.

4.1 Compliance with Permitted Activity Rules

In accordance with Section 3(a) of Schedule 4 of the RMA, a description of each of the ancillary permitted activities is given in Table 5 below.

Table 5: Summary of ancillary farm activities compliance with relevant permitted rules

Activity	Compliance with the relevant permitted rules of the RWP and PSWLP
Culverting *(Rule 28 RWPS & Rule 59 PSWLP)*	As the property has existing laneways no new culverts will be required to be installed as part of the conversion.
Stock drinking water	The provisions for stock drinking water are in accordance with the provisions of Section 14 of the (RMA), permitting the take and use of water for the reasonable needs of an individual's animals for stock drinking. The volumes of water sought are permitted under Rule 54 of the PSWLP.
Water storage	The applicant intends to install water storage tanks at the dairy shed, which enables the storage of water for stock drinking and dairy shed wash down purposes. Storage of water is a good management practice which will enable efficient use of the water resource.
Fertiliser *(Rule 10 RWPS & Rule 14 PSWLP)*	All practicable measures will be taken to minimise fertiliser drift beyond the target areas. Fertiliser will be applied to selected areas of the property in accordance with nutrient budget recommendations, and soil tests to avoid excess leaching of nutrients to groundwater. The applicants have also proposed to split application of fertiliser through the year to maximize plant uptake and to avoid sensitive times of

Activity	Compliance with the relevant permitted rules of the RWP and PSWLP
	application. Fertiliser will be applied when a soil water deficit exists, and all waterways will have riparian margins with stock excluded.
Silage storage and Silage Leachate *(Rule 51 of the RWPS, & Rule 40 and 41 of the PSWLP.)*	It is intended that any silage storage facility on the property is located away from sensitive receiving environments, in accordance with permitted rule setbacks and no direct discharge of silage leachate to any waterbody is proposed.
Sludge *(Rule 5.3.1 of the RELAP & Rule 38 of the PSWLP)*	Solid sludge effluent collected from the proposed stone trap and any sludge/solids from the pond when the pond is cleaned out will be laid out to dry on a nearby concrete drying pad, is to be spread on to selected paddocks located within the dairy platform. Disposal of solids will not be directly to any waterway. The application of solids to land will observe the appropriate separation distances from sensitive areas. Solids are to be applied to land on days when conditions are suitable (i.e. when a soil water deficit exists) avoiding surface-run off and at a depth no greater than 7mm. Additionally no sludge will be discharge to land from 1 May – 30 September in any year.
Cleanfill, Farm Landfills and Offal Holes *(Rules 53, 54 & 55 of the RWPS, & Rules 42, 43 & 44 of the PSWLP)*	No more than 500 m^3 of material will be discharged within cleanfill sites on the property. Stormwater will be directed away from fill areas and no unauthorised material will be placed into proposed fill areas. No naturally formed limestone rock is known to reside within the property. Excavation of fill holes do not intercept springs and are not below the seasonal mean groundwater level in that location. The areas specifically highlighted in Rule 53(a)(ii), 54(a)(iii) and 55(a)(iii) (RWPS) can be easily avoided when undertaking these associated activities. Furthermore, offal sites are to be covered and the surfaces to be restored to a similar state as surrounding land upon closing.
Drainage of Land *(Rule 9 RWPS & Rule 13 PSWLP)*	The discharge of land drainage water from an installed subsurface drainage system to water is a permitted activity. It is not anticipated that any discharge from subsurface drains would result in a conspicuous change to the colour and/or clarity of the receiving waters at a distance of 20 metres from the point of discharge. The proposed good management practices will significantly reduce the likelihood of any contaminants reaching the subsurface drains, including very low rates of effluent application. Installed subsurface drains are important to the economic and productive operation of farms throughout Southland.
Intensive Winter Grazing *(Rule 23 PSWLP)*	From the 30 May 2018, and provided that the relevant conditions are met, the use of up to 50 ha of land for intensive winter grazing, being the grazing of stock on fodder crop between May and September inclusive, is a permitted activity within the Gleyed Physiographic zone. The applicant has prepared a FMP in accordance with Appendix N of the PWSLP, the location of known tile drains have been identified, the area of land used for intensive winter grazing would be provided to Environment Southland upon request, appropriate buffers from waterbodies are to be observed.
Discharge of effluent from feed lots and wintering pads *(Rule 35 of the PSWLP)*	Discharges of effluent from one feedlot/wintering pad per landholding, which from 1 January 2018 service no more than 100 adult cattle (at any one time) and is greater than 20 m from the nearest tile drain and surface waterbody, and all other specified conditions are met therefore would be considered a permitted activity.

4.2 Other Resource Consents Required

No other resource consents are required.

5. CONSULTATION AND NON- NOTIFICATION

A consent authority has the discretion whether to publicly notify an application unless a rule or National Environmental Standard (NES) precludes public notification (in which case the consent authority must not publicly notify) or section 95A (2) applies.

The effects of the activities will be no more than minor, the applicants do not request public notification and there are no rules or NES' which require the public notification of this application. Additionally, there are no special circumstances that exist in relation to this new application as would be required to publicly notify an application pursuant to Section 95A (4) of the RMA. For completeness, it is noted that consultation with potentially affected parties including the Department of Conservation, Fish and Game, Te Ao Marama Inc, and Ngai Tahu will be undertaken upon lodgment of this application.

Consultation was undertaken with adjoining landowners regarding the proposed dairy conversion and the associated activities during the 2015 consent application. Affected person's approval was obtained from all the adjacent and adjoining neighbours, with the signed written approvals appended to this report as Attachment F.

Pursuant to Section 95E of the RMA, Council must decide that a person is affected and it is anticipated that Council will advise of any need for further written approvals after an initial assessment of the proposal has been made.

6. ASSESSMENT OF ENVIRONMENTAL EFFECTS

Schedule 4 of the RMA sets out a number of matters that must be addressed by an assessment of the effects of a proposal seeking resource consent on the environment. However, Schedule 4 of the RMA also recognises that '*a requirement to include information in the assessment of environmental effects is subject to the provisions of any policy statement or plan*'[6]. All relevant provisions under the RWPS and PSWLP have been assessed below. Additionally, assessment under the RELAP is given regarding the discharge of farm dairy effluent to a combination of flat and sloping land.

The assessment prepared for these applications is to be considered a complete assessment of the effects of the proposals on the existing environment. It also identifies that where an application is for a controlled or restricted discretionary activity, an assessment of any actual or potential effects that the activity may have on the matters over which the Council will exercise control or restrict its discretion to are included.

6.1 Effects of New Dairy Farming

Expansion of the dairy industry in Southland through the establishment of new dairy farming will be a significant contributor to the regional economy. However, the effects on water quality require management for the sustainability of the industry in the region. It is noted that the purpose of Rule 17A, which allows for the conversion of a property to dairy is not to prevent the establishment of new dairy farms, but to ensure each new development is sustainable from an environmental, social, economic and cultural view point.[7]

The potential effects and risks from a dairy conversion and the ongoing use of land for dairy farming are required to be addressed by the applicant in accordance with Rule 17A of the RWPS and Rule 22 of the PSWLP.

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[6] Clause 6(2) and 7(2) of Schedule 4 of the RMA.

[7] Rule 17A, Regional Water Plan for Southland, 2010.

A management plan approach has been adopted. This approach involves the implementation of a CEP which includes a management plans relating to nutrients, soil, waterway, effluent system and biodiversity, and operates as a management plan throughout the duration of the conversion process. Environment Southland have recently introduced the requirement for a FMP, which is intended to be operative throughout the duration of a farming activity, including the ongoing operation of a dairy farm. The FMP and CEP are similar documents, which generally aim to identify the specific risks of dairy farming on the subject property and measures to address those by way of appropriate good management practices (GMPs). Both documents are included for completeness given that approvals are required under both the RWPS and the PSWLP, however practically the applicant would promote the FMP as the primary document for managing the effects of the operation of the site as a dairy farm.

To achieve cohesion within this assessment and the attached CEP and FMP, this report assesses the actual or potential effects of the proposed conversion on the environment while the management plans contain a description of the operational elements of the proposal as well as the good management practices (GMPs), monitoring, contingency planning for the farm.

All applications for a dairy conversion are required to calculate a soil versatility rating based on the soils present on the milking platform. The soil versatility rating determines how the application for a conversion should be considered, and the scale of the CEP. In this case the versatility rating of the applicant's property was assessed by Council and given a rating of 10 which requires a Category 1 Farm Plan to be prepared which includes standard farm management practices plus any site-specific standards.

A more comprehensive CEP has been prepared (i.e. as if it were for a Category 3 farm) for this property as the applicant wishes to take a conservative approach, and as a consideration for the sensitivity of the catchment generally. The management strategies outlined in the CEP, having been prepared to the standard of a Category 3 Farm, therefore go over and above the requirements of the RWPS, and the generally accepted best practice standards.

6.1.1 Nutrient Use Efficiency

Nutrient Budgets and a Nutrient Management Plan (NMP) for the proposal have been prepared by Miranda Hunter of Roslin Consultancy Limited. The nutrient budgets have identified nutrient sources on the property with appropriate management proposed within the NMP. The NMP has been appended to the CEP and FMP (Attachments B and C).

Examples of nutrient sources include discharge of FDE, animal discharges (i.e. urine) and atmospheric nitrogen fixation. The predicted nutrient losses (as a result of the proposed conversion) to water are not excessive when considered within the context of the expected range of a dairy farm. The proposed average stocking rate, reduces the intensity of the operation of the farm avoiding poor management decisions from occurring when resources are under pressure, such as overgrazing and over-cultivation of the same paddocks on shoulders of the season. An average stocking rate of 2.97 cows/ha is within the South Island Average[8]. Table 6 below presents the nutrient losses expected from the conversion as estimated by OVERSEER®.

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[8] http://www.lic.co.nz/user/file/DAIRY%20STATISTICS%202014-15-WEB-6%20NOV%2015.pdf

Table 6: Summary of estimated nutrient losses to water

Land Use	Nitrogen Losses (kg/ha/year)	Phosphorous Losses (kg/ha/year)
Existing Land Use (Dairying grazing and beef unit)	40	0.4
Dairying (306 cows 123,600 kg MS)	25	0.7

The nutrient budget predicts nitrogen loss over the whole farm of 25 kg/ha/year and a phosphorus loss of 0.7 kg/ha/year, for a 306 cow herd, which is within the average range for NZ Dairy Farms (24-42kg N/ha/yr). This figure does not represent an excessive amount of potential leaching. The overall phosphorus loss for the property is 0.7 kg/ha/yr which is considered to be low.

It is noted that it is not the volume of good management practices implemented but the level of effectiveness of each GMP which is of highest value for mitigating potential effects of dairy farming on the identified receiving environments.

All stock are to be wintered off the property, and outside the Waituna catchment. A concrete pad is to be adapted and is to be used in conjunction with the milking shed yards for standing stock off wet paddocks as well as feeding.

6.1.2 Potential Water Quality Effects

The RWPS identifies four main contaminants of concern:

- **Nitrogen and Phosphorous** (nutrients) are needed by plants for growth but when there are too many nutrients in water, it can result in eutrophication and toxicity for humans and animals. High levels of nitrate in water can make it unsafe to drink for humans and can be toxic for sensitive organisms (like young trout and salmon). Ammonia is highly toxic to fish and other creatures that live in water (at lower concentrations than nitrate) and too many nutrients in water can lead to excessive plant growth, algal blooms and depletion of oxygen in the water;

- **Sediment** (or water clarity) refers to particles of eroded soil and rock. Sediment is also a major source of phosphorous because phosphorous sticks to the surface of soil particles carried to water. When erosion rates are excessive, sediment can damage instream plans (effectively abrading and scouring them away) and can damage the gills and delicate body parts of invertebrates and native fish. Finer sediment suspended in water can also reduce light penetration (visibility) which plants need to grow and some creatures need to find food. Where sediment blankets the bed of a waterway, it can smother and kill plants and animals (this problem can be particularly severe in estuaries); and

- **Bacterial micro-organisms** (or pathogens) which can have a detrimental effect on human and animal health, particularly when ingested. The main sources of pathogens in fresh water in New Zealand are human sewage and animal manure[9].

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[9] Parliamentary Commissioner for the Environment, 2012. *Water quality in New Zealand: Understanding the science.* New Zealand Government, Wellington. 76p.

These contaminants are the focus of the water quality assessment attached as the Technical Assessment (Attachment D), and summarised in Section 6.1.3 below.

6.1.3 Water Quality Assessment

The following section provides a summary of the detailed water quality assessment within the attached Technical Assessment prepared by Karen Wilson. Nutrient losses from the existing and proposed land use have been estimated for the property using the OVERSEER® model (version 6.2.3).

The following table summarises the modelled losses from the current and proposed scenarios:

Table 7: Summary of modelled nutrient losses from the property [Source: Roslin Consultancy Ltd]

	Current	*Proposed*
Whole Farm		
Nitrogen	40 kg N/ha/year	25 kg N/ha/year
	8.6 mg/L*	5.6 g/m^3
Phosphorus	0.4 kg P/ha/year	0.7 kg P/ha/year

There is a reduction in N losses to water, because of the proposed land use. There is also a reduction in N concentration in water, with the weighted average nitrate concentration in drainage water across the effective area of the property is modelled as 5.6 g/m^3 which is below the DWSNZ maximum acceptable value of 11.3 mg/L. The modelled nutrient losses represent losses from farm before any attenuation, dilution or accumulation that may occur in the receiving environments and are therefore is only a guideline of the potential environmental effect on water quality, and which may in fact be less than what has been modeled. These proposed reductions in N loading, when considering the sensitivity in the receiving environment are environmentally beneficial and consistent with the relevant documents and policies for reducing effects on water quality, while there are yet no catchment limits.

The Technical Assessment also outlines that nutrient flows within the catchment are typically quite quick in that, changes in land use are measured quickly in the environment. Not only will a reduction in the current effects on the environment come to effect, these will be rewarded quickly in the receiving environment. Those losses expected as a result of the proposed activity of 25 kg N/ha/year is toward the lower end of the typical range for New Zealand dairy farms (i.e. average between 24 – 42 kg N/ha/year). Nutrient modelling suggests nitrogen loss will be reduced by 38 % under the proposed activity and phosphorous loss will increase. Published reports show current nutrient loads to the Waituna Lagoon are compromising ecological health within the lagoon (particularly in relation to the keystone species *ruppia*). Therefore, any reduction in nitrogen loads will assist in improving water quality and ecological health in the lagoon.

This presents an ideal opportunity for remedying any adverse effects on water quality in this catchment.

In terms of the expected Phosphorous losses, Table 7 above indicates an overall increase from the current land use activity (from 0.4 kg P/ha/year to 0.7 kg P/ha/year). This figure does not represent an excessive amount of potential leaching, and is considered to be low for the type of activity proposed i.e. less than the expected range for a dairy farm). When looking at the sources of P losses on farm, P loss at the block level remains similar when you compare the current and the proposed scenarios in OVERSEER®. Under the proposed land use, risk of P loss from fertiliser and effluent application is assessed as low (which on a scale of low – extreme, low is ranked the bottommost risk possibility). As noted in the attached Nutrient

Management Plan, 'other' sources account for 9 kg P / ha / year in the existing operation and 44 kg / ha / year in the proposed conversion. 'Other' sources in OVERSEER® are estimated based on potential losses from standoff/feed pads, races and yards, and effluent management systems (such as from uncovered stored solid effluent). Therefore, the main driver for the predicted increase in P loss from the property, is derived from 'other' farm sources, and not as a result of increase loading at the block level.

While OVERSEER® makes a number of good management practice assumptions to estimate nutrient outputs, there are many more management practices which can be employed on farm to eliminate or minimise nutrient losses on farm, which are not considered in the OVERSEER® model. In particular, OVERSEER® does not currently account for many of the possible farm management techniques that can be employed to manage P loss from 'other sources' (*pers. Comms.* Miranda Hunter, 2016). For example, Table 8 below presents a list of potential management tools which will result in less P loss to water and summarises whether or not they are rewarded in OVERSEER® and which management practices the applicant will undertake to minimise P loss on farm under the proposed dairy conversion.

Table 8: Management tools that will reduce P losses to water[10]

Phosphorous Loss Mitigation	Rewarded in OVERSER®?	Proposed to be implemented
Fencing Streams	*Yes*	✓
Appropriate fertiliser rates	*Yes*	✓
Conversion to more efficient irrigation systems	*Partially – already assumes very high efficiency*	✓ *(no flood irrigation will occur)*
Avoiding high risk times for fertiliser application	*Yes*	✓
Change fertiliser type	*Yes*	✓ *(low solubility P fertiliser)*
Targeting optimum Olsen P	*Yes*	✓
Precision fertiliser placement	*Partially – through lower application rates*	✓
Cultivating with contour – rather than up and downslope	*No*	*Not applicable (flat land)*
Infrastructure to keep stock away from unfenced streams (e.g. troughs, shade)	*No*	
Culverts and bridges	*No*	✓
Managing track runoff	*No*	✓
Shifting break fences strategically	*No*	✓ *(strategic grazing of winter forage crop)*
Filter areas downstream of unfenced waterways	*Partially – only if wetland able to be captured*	
Uncultivated ephemeral stream margins	*No*	✓ *(grass buffer strips/uncultivated ephemeral stream margins – increased sizing for critical source areas)*
Erosion control plantings	*No*	✓ *(riparian planting)*
Spread fertiliser evenly	*No – assumed already*	✓
Reducing ability of stock to form camps	*No*	

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[10] *Hurunui-Waiau Nutrient Budgeting Case Studies*, report prepared by Rebecca Hyde & James Hoban (December 2014). http://www.landcare.org.nz/files/file/1445/Hurunui-Waiau%20Nutrient%20Budgeting%20Case%20Studies.pdf

Phosphorous Loss Mitigation	Rewarded in OVERSER®?	Proposed to be implemented
Avoiding applying fertiliser directly to streams	*No*	✓

Additional GMPs not listed in the table above, but to be implements to reduce potential P losses to water include, looking at options to amend tile drains, using very low rate effluent application, providing sufficient effluent storage to enable deferred application, standing cows off paddocks on the shoulders of the season, minimising the time paddocks are left bare after grazing of crop and resowing to grass as soon as practicable, and strategic placement of crops, appropriate buffers from water ways, strategic grazing including remaining crop cover after grazing, under sowing kale cops with grass, identification of critical source areas with regards to P loss, cambering lanes away from waterways and for runoff to be directed into vegetative areas, stock crossings appropriately designed and high traffic areas visually monitored, with nib walls along the side to direct runoff the vegetative areas, wintering stock off farm during critical months (1 June – 31 July), swales which run into creeks are to be fenced with a wider buffer zone to act as an additional filter.

In order the avoid the highest risk periods and practices that are detrimental to water quality, a series of proposed mitigation measures along with the expected environmental outcomes have been proposed in Table 9 of the attached Technical Assessment (Attachment D).

While P losses are predicted to increase under the proposed scenario, the losses are not excessive in the context of other surrounding consented dairy farms and are considered low in the range of other dairy farms in New Zealand, and therefore not uncertain or unexpected with regards to the scale of the activity proposed. The P losses modelled by OVERSEER represent 'worst case scenario' on the basis that a number of GMPs to be implemented on farm are effective at reduced P loss and are not rewarded in the OVERSEER® model. Therefore, it is reasonable to ascertain the idea that actual loses on farm could be much less than predicted. Furthermore, the applicant proposes surface water quality monitoring to measure the actual effects of the proposed activity on water quality, and the FMP provides an appropriate platform for adapting management practices to measured environmental outcomes.

The scale of nutrient losses associated with the proposed change in land use are considered to be small.

Furthermore, the attached Technical Assessment and nutrient budgets have assumed a minimum effluent disposal area of 26 ha. It is noted that effluent generated at the dairy shed and feed pad is to be spread to a maximum area of 96 ha of land. When a greater effluent disposal area is modeled using OVERSEER® the overall average P, N and K losses are generally reduced as a result of a greater effluent disposal area. The attached Technical Assessment and Nutrient budget therefore represent an effluent disposal scenario which is the minimum requirement for best practice (8ha/100 cows) which is a conservative approach, and it is highlighted that the actual applied for area of 96 ha equates to an effluent disposal ratio of 31 ha/100 cows.

Given the soil properties and flat topography present within the effluent disposal area, the main transport mechanism for phosphorus, nitrogen, sediment and microbe loss is interpreted to be via artificial drainage. Contaminant losses via these pathways can be mitigated by managing critical sources areas. Recommended land management mitigations to reduce water quality impacts from the physiographic zone present on the property (Gleyed) are proposed in the attached Technical Assessment.

With respect to microbiological contamination from pastoral farms, research by AgResearch[11] shows that late autumn until mid-spring is the high-risk period as this is when surface runoff and mole-pipe drainage is most likely to occur. They also note that *"not all areas of the landscape contribute to flow pathways of loss. Those that do are termed critical source areas and are characterised as being directly "connected" to water bodies"*. AgResearch suggest that improved effluent management, stock exclusion and the elimination of stock crossings will have the greatest impact in reducing microbiological contamination from pastoral farms and after that, large populations of waterfowl are likely to be the next highest contributor.

In terms of the effects associated with the nutrient losses from the proposed land use is considered to be less than minor. A report regarding water quality and the receiving environments is appended as Attachment D.

6.1.4 Cumulative Effects Assessment

Regional scale modelling of nitrogen and phosphorous losses from agricultural land use in the Southland Region by Aqualinc in 2014[12] showed:

- Adoption of mitigation measures on farms could result in reductions in nutrient loads discharged in Southland;
- Within the agricultural sector, nutrient loss from dairy farms make up a disproportionately large proportion of the nutrient load in most Southland catchments compared to the farm area;
- Adoption of mitigation measures on dairy farms alone significantly reduces catchment scale improvements in nutrient losses because sheep and beef farms make up the greatest area of land use[13]. Overall, contributions from both land uses are significant; and,
- Under the status quo of ongoing conversions and increasing production on dairy farms, water quality will not be maintained or improved in the long term even if very stringent mitigation requirements were to be adopted. Setting limits for catchment nutrient loads and then managing discharges to meet these limits appears to be the most appropriate method of ensuring the goal of maintaining and improving water quality in Southland will be achieved.

Although this study shows dairying is a significant contributor to nutrient loads in the Southland Region, it does not consider the receiving environment's assimilative capacity.

Based on the information available, the attached Technical Assessment has concluded that the proposed activity is likely to reduce Nitrogen accumulation in the Waituna Catchment, and that the results of reduced loading in the catchment would be expected to be seen quickly.

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[11] Monaghan, R. M., Semadeni-Davies, A., Muirhead, R. W., Elliott, S and Shankar, U., 2010. *Land use and land management risks to water quality in Southland*. Prepared for Environment Southland, April 2010.

[12] Aqualinc, 2014. *Assessment of Farm Mitigation Options and Land Use Change on Catchment Nutrient Loads*. Prepared for Environment Southland, report number C13055/04.

[13] Adoption of the M1 mitigation package on all farms (i.e. mitigations most easily implemented) reduced agricultural nitrogen loads by 18 – 32% however when only dairy farms adopted M1, nitrogen loads were reduced by only 1 – 6%. Similarly, when all farms adopted M3 (i.e. the most effective but most expensive mitigation measures), nitrogen loads were reduced by 29-37% and phosphorous loads by 40-80% however when only dairy farms adopted M3, nitrogen and phosphorous loads were reduced by 2-18% and 5-32% respectively.

An assessment of the potential for cumulative effects to arise as a result of the proposal is appropriate, specifically in the context of potential effects on water quality and the location of the property within a sensitive catchment. The property area represents less than 0.6% of the total catchment area, and given the relatively small changes in nutrient loss estimated by OVERSEER® modelling any numerical assessment of the effects on water quality are unlikely to be measurable.

Implementation of mitigation strategies, such as exclusion of stock from waterways, and best management Farm Dairy Effluent Management have proven to reduce catchment loads. As such the implementation of these mitigation strategies, in addition to those outlined within the CEP/FEP and the attached Technical Assessment are likely to result in a reduction in catchment loads.

It is anticipated that subject to adherence to the strategic farm measures proposed in the CEP/FEP as well as the consultation and working relationship with Land Sustainability, the ongoing adaptive management of the dairy farm post dairy conversion including undertaking regular nutrient budgets, regular monitoring of effects, and ongoing best management, adverse actual or potential effects on the receiving environment in the long term as a result of the conversion are sufficiently avoided, remedied or mitigated.

In considering the potential for cumulative effects, we believe that these can be avoided, remedied or mitigated through conditions of consent such that the overall cumulative effects of the proposal are likely to be lower than those that might accumulate under alternative land use scenarios.

Overall, the use of the land for dairy farming is not expected to cause an adverse effect on the environment greater than the current land use during the milking season because of the use of low rate irrigation and deferred storage (see Section 5.2 of this report). The predicted nutrient losses to water are not excessive, and the low stocking rate and design of the milking platform should mitigate the effects of discharging effluent onto soils which are vulnerable to nutrient leaching.

6.1.5 Conclusion

The main receiving environment is McMillan Creek which drains into the Waituna Creek. Groundwater underneath the property is part of the Awarua Groundwater Management Zone (previously the Waihopai Groundwater Management Zone).

Available monitoring data suggests the main water quality issues with the catchment are excessive levels of nutrients (nitrogen and phosphorus) and sediment in the Waituna Lagoon, and high levels of nitrogen in the Waituna Creek (when compared to other similar sites across New Zealand) contributing to algae blooms.

OVERSEER® modelled losses for the property under the proposed land use, demonstrate that nitrogen losses are within the lower end of typical range for New Zealand dairy farms, and will represent a reduction in N loss from the currently permitted activities. Based on the environmental setting and water quality data, it is interpreted the main transport pathways for contaminants from the property are artificial drainage.

Contaminant loss associated with sustained wet periods and storm events will be avoided by using low rate, deferred effluent irrigation along with stock exclusion from waterways and vegetated buffers from waterways, all stock will be wintered off farm between 1 June and 31 July. Furthermore, the installation of a standoff/feed pad will enable stock to be removed from paddocks in the shoulders of the season under certain weather conditions. Excessive nutrient application will be avoided by managing imported supplements and fertiliser application in accordance with a NMP.

While the proposal when modelled by OVERSEER® anticipates an increase in phosphorous loss and a reduction in nitrogen loss, on average the nitrate concentrations are well within the DWSNZ maximum acceptable value, and within the NOF nitrate toxicity bottom line. The anticipated losses for phosphorous are within the New Zealand dairy farm average (with wintering off) of 0.8 – 1.3 kg/P/ha/year.

The mitigation strategies proposed in this application are intended to minimise contaminants entering the artificial drainage network. It is noted that no treatment of artificial drainage discharge is currently proposed (e.g. such as sediment traps or wetlands) prior to entering surface waterways, ongoing water quality monitoring may suggest whether or not an increase in P loss is experienced, and the FMP review process will enable the applicant to adaptively manage and update any required Good Management Practices on farm.

It has been assessed that while the proposal is anticipated to result in an increase of P losses from the farm, those losses are within the expected range for a dairy farm and are therefore not excessive in the context of other surrounding consented land uses. It has also been recognised that those losses modelled do not take into account the assimilative capacity of the receiving environment, and those losses are based around a smaller effluent disposal area than what is proposed. 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 National Policy Statement for Freshwater Management, 2014), it is difficult to assess where the cumulative effect threshold applies in reference to an individual activity.

While it is not likely that the proposal will result in any significant adverse effect, surface water quality monitoring is proposed to be undertaken on the McMillan Creek at a point upstream and downstream of the proposed conversion area prior to conversion and after the conversion is complete. Ongoing water quality monitoring throughout the duration of any land use consent to use land for dairy farming is also proposed.

6.2 Effects of Effluent Discharge

A number of parameters are used to assess actual or potential adverse effects of the discharge of FDE to land. These generally relate to the sensitivities and assimilative capacities of receiving environments as well as risk factors associated with farm management practices. The following assessment addresses the parameters of the discharge within this context and refers to standards and best practices where these are relevant.

6.2.1 Regional Plan Requirements

Overall, the discharge of effluent to land is considered a discretionary activity. The following assessment has been prepared against those matters outlined in Rules 50 (d) (i) and 50 (d) (ii) of the RWPS, Rule 5.4.6 of the RELAP and Rule 35(b) of the PSWLP, on the basis that these rules are of most relevance to the activity as proposed.

(a) *application depth and/or rate, storage requirements, nutrient loading (in particular nitrogen) and, the size of the disposal area, timing and contingency plans;*

Application Depth and Rate

According to Policy 42 of the RWPS, the rate of application of FDE to land is not an essential criterion. However, low application rates of effluent should allow for an application depth of 25 mm to remain in the top 200 mm of the soil which can be used by plants[14]. Low rate application also allows for the avoidance of a range of actual or potential adverse effects such as ponding, odour, overland flow and/or nutrient leaching and microbial transfer to waterways. As such, a system capable of achieving a low instantaneous rate not exceeding 10 mm/hour will be installed for these reasons.

A slurry tanker may also be used generally as a contingency measure, and slurry tankers are known for being able to apply at low rates and depths. Investment will be made in establishing low rate effluent irrigation on the properties, and in storage (discussed below).

Recommended application depths for artificially drained soils or soils with impeded drainage or low infiltration all refer to a target depth as the 'soil water deficit'. In Southland, regular soil water deficits greater than 10 mm mainly occur between the months of October and May which makes it difficult to accurately schedule the application of effluent to coincide with soil moisture deficits over the entire milking season which usually begins in August. Therefore, forecasting of weather and checking the nearest soil moisture site on the ES website will ensure that effluent is applied only when a soil water deficit exists. Although the property has mole / tile drains at depths of about 500 mm careful irrigation scheduling will ensure that low application rates to depths not exceeding soil water deficits maintains nutrients within the top 200 mm of soil, enabling the assimilation of nutrients into a form which can be used by plants[5], while facilitating the avoidance of a range of actual or potential adverse effects such as ponding, odour, overland flow and/or nutrient leaching and microbial leaching in waterways.

This system is sustainable in the long term and allows the effluent to be utilised as both a fertiliser and a soil conditioner.

The effluent will not be discharged onto any land area that has been grazed within the previous 5 days as soil compaction from stock treading presents with risk of ponding, overland flow and low plant nutrient uptake. This will further avoid the identified soil vulnerabilities associated with structural compaction. Effluent discharge will observe a 28-day return period. Effluent is proposed to be discharged to land year-round, on days when conditions are suitable.

'Proof of placement' of irrigators provide a record of effluent application, and the required information to make informed decisions daily and seasonally regarding the forecasting of FDE disposal. Records will be maintained and kept, which may be in the form of irrigator run sheets or a Fonterra Dairy Diary.

Furthermore, RD Agritech Limited have noted that if the instantaneous irrigation rate is higher than the Ksat value the soil cannot absorb it fast enough which will result in ponding on the surface[15], and therefore the potential for discharge via artificial drainage or overland flow. To manage the potential risk of this, the discharge of effluent has been designed so that during the wetter parts of the year the system can be

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[14] McLeod M, Schipper LA, Taylor MD (1998) Preferential flow in a well-drained and a poorly drained soil under different overhead irrigation regimes. *Soil Use and Management*, 14, 96-100.

[15] Schrader Effluent Design Report, RD Agritech, Section 4.1, Page 7.

pulsed to apply effluent at a rate of 2mm/hr which is a very low rate designed to avoid over application and the potential for discharge via overland flow or artificial drainage.

Storage and Distribution

The effluent system will consist of an in-ground storage pond with an operational storage capacity of 930 m^3, which is greater than the minimum 90 % probability storage volume required (834 m^3). This calculation has included provisions for the use of a concrete pad and milking shed yard areas to be used as a stand-off/feeding area if needed. This exceeds the Council's Best Practise Guidelines for low rate irrigation systems and is consistent with the computations of the Dairy Effluent Storage Pond Calculator.

Liquid effluent will then be pumped to the receiving paddocks via an underground pipeline network. Effluent is to be discharged to a maximum area of 96 ha via low rate infrastructure.

The proposed system incorporates both low rate irrigation and substantial deferred storage to ensure that irrigation only occurs when soil moisture deficit exists. This combination should result in little adverse effect on the environment.

Controls will be put in place to ensure that the manager in charge of the effluent collection and distribution system undertakes monthly inspections with some aspects monitored daily which will be controlled by the FMP.

Staff will be aware of FDE application requirements and Council will continue to be notified of any changes in personnel in charge of managing the effluent system no later than 5 working days after that person takes responsibility.

Effluent Disposal Area

The applicant proposes an effluent disposal area of 96 ha, which comprises both Woodlands and Dacre Soils. The underlying physiographic zone is Gleyed with no variants, although the presence, depth and location of tile drains within the effluent disposal area are known and shown on the attached Tile Drain Map (Attachment B). The disposal area observes all appropriate buffers.

Nutrient Loading and Water Quality

The minimum disposal area to receive effluent generated from 306 cows is 26 ha is recommended in the Council's Best Practices Guidelines. The proposed discharge area of 96 ha provides a ratio of disposal area to volume of effluent generated of 31 ha/100 cows.

Whilst effluent and farm system management is quite complex from a nutrient perspective, a nitrogen loading rate of 150 kg N/ha/year or less would be achieved under the proposed disposal area size. The Nitrogen loading over an effluent area of 26 ha (which is a conservative estimate of the effluent disposal area for the proposed conversion Nutrient Budget Scenario) equates to 92 kg/N/ha/year. The application is for the provision of a maximum 96 ha effluent disposal area over predominantly Woodlands soils (95%), with Dacre soils making up the remaining 5 % of effluent disposal area. Spreading effluent over the larger area will avoid applying FDE to land when it is not particularly capable of receiving the FDE due to physical effects on soil structure or soil water at or above field capacity. This should also result in a greater rate of nutrient uptake by the soils and therefore it is expected that actual losses over the proposed effluent area will be much lower than 92 kg/N/ha/year.

Using the minimum area of land to receive effluent when using OVERSEER® is common practices as it indicates a 'worst case' scenario, and presents a maximum loading of N derived from effluent application. It is noted that the proposed nutrient budget only presents the woodlands soils as receiving effluent. Consistent with the comment provided from Environment Southlands Overseer Peer Review Report[16] it isn't considered that having modelled the Woodlands soil type as the effluent area will make a significant difference to the modelled OVERSEER® nutrient outputs, on the basis that the soil types are similar in nature.

The amount of nitrogen loading per year as a result of effluent discharge is 93 kg N/ha/year, based on 26 ha receiving block.

Contingency Plans

An alarm and automatic switch-off system as a contingency measure in the event of an effluent system failure such as sudden pressure drop, irrigator stoppage or breakdown.

A Slurry tanker may be used at certain times as a contingency method.

Further details of FDE system management and monitoring (including the contingency plans) can be found in the RD Agritech Limited report (Attachment E). These contingency plans will follow through to the Management Plans as well.

(b) *the separation distance (beyond that required) of the discharge from surface water bodies, artificial watercourses, subsurface drains, the coastal marine area, residential dwellings, places of assembly, urban areas, property (landholding) boundaries, water abstraction points and registered drinking-water supplies;*

The following buffer zones are proposed:

- 20 metres of any surface watercourse
- 100 metres of any potable water abstraction point;
- 20 metres to any landholding boundary; and
- 200 metres of any residential dwelling other than residential dwellings located on the property.

The proposed FDE discharge area is contained within the attached Management Plans, and demonstrates the proposed separation distances which are to ensure that any effects on water quality from direct discharge are avoided.

All waterways are to be fenced allowing buffer zones of 3 meters from the waterways between grazed pasture and the waterway. Additionally, all riparian buffers are intended to be appropriately planted.

Furthermore, the location of the effluent storage pond observes all relevant separation distances as discussed in Section 6.4 of this report.

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[16] Phillips, N. 2016. Overseer Modelling Report for: Environment Southland.

The proposed effluent application method can achieve depths of application as shallow as 2 mm – 10 mm, with regards to the typical tile drain located at least 500 mm beneath natural ground level the proposed depth of application will observe an appropriate separation distance from subsurface drains.

There are no other sensitive receiving environments that require any further separation measures to be implemented at this location.

> ***(c)*** *other measures to avoid, remedy or mitigate adverse effects (including cumulative effects directly related to the discharge of farm dairy effluent) on water quality taking into account the nature and sensitivity of the receiving environment,* including the physiographic zone that the discharge is located in.

This point is discussed above in sections a-b and further in Section 6.2.2 below.

> ***(d)*** *the duration of the discharge permit to be issued, in order to implement the outcomes of any Freshwater Management Unit Process to be undertaken in accordance with Policy 1;*

As outlined in Attachment G, the proposed conditions of consent include a review condition under Section 128 of the RMA, to *"ensure that the Mataura Freshwater Management Unit and Waituna Freshwater Sub Unit meets the freshwater objectives and freshwater quality limits set in an operative regional plan pursuant to Policy A1 of the National Policy Statement for Freshwater Management."* Further consideration of the duration of the consent sought is given in Section 8 of this report.

> ***(e)*** *the adequacy of information provided to demonstrate that any pond, tank or structure used to store agricultural effluent prior to discharge does not leak; and*
>
> ***(f)*** *the structural integrity of any pond, tank or structure used to store agricultural effluent prior to it being discharged*

The effluent pond is to be constructed to the appropriate standards prior to the first exercise of this consent. Further assessment of the proposed effluent storage is provided in Section 6.4 of this report, and the attached RD Agritech Limited report.

Conclusion

Any actual or potential adverse effects of the proposal can be considered as no more than minor with measures taken to mitigate and remedy such effects on the environment as per the Effluent Management Section of the Attached CEP and FMP.

6.2.2 Effects on Water Quality

As identified above in Section 6.1.2, the four main contaminants of concern under the RWPS are Nitrogen and Phosphorous, Sediment and Bacterial micro-organisms.

Contaminant movement to water receptors is dependent on a number of environmental circumstances. Environmental determinants for contaminant transfer from land-based application of FDE include the condition, character and quality of the soils, climate, and anthropogenic influences such as the presence of artificial drains. The proposed discharge of FDE is to predominantly Woodland soils, while Dacre soils will be present within some minor area of the proposed effluent disposal area, it is anticipated that these soils will typically be avoided due to their proximity to an unnamed tributary of the McMillan Creek and the provision of 20 m buffers around all waterways on the property.

The physiographic zone associated with the effluent disposal area is Gleyed. Soils in the Gleyed zone generally have low subsurface permeability, making them prone to seasonal waterlogging. As a result, these soils are typically artificially drained, which is consistent with those soils present within this area. Measures to avoid, remedy or mitigate the effects on water quality from these critical source points are discussed below.

The primary water quality risk associated with the Gleyed physiographic zone are event-driven, rapid export of contaminants to surface water via overland flow (where there is sufficient slope) and mole-pipe drains when soils are wet (typically between late autumn and early spring). Soils within the Gleyed zone are capable of denitrification provided there is sufficient residence time of water within the soil profile. During storm events, discharge from mole-pipe drains will initially contain denitrified soil water from water that has been residing in the soil profile. However, as the storm event proceeds, this water will be displaced with recharge water that has rapidly moved through, or via the soil profile to the artificial drainage network. This water has insufficient contact time with the soil profile for denitrification to occur, and rapidly transports contaminants to surface waterways.

Effluent disposal is not proposed to occur when soils are at or above field capacity, and does not occur in such a way to bring soils to field capacity. In addition, the proposed on-site storage means effluent disposal can be avoided during high risk periods (i.e. late autumn to early spring). By restricting effluent irrigation to periods where drainage events are less likely to occur, there is greater opportunity for soils in this zone to attenuate nitrogen through denitrification in the soil zone. Similarly, it reduces the risk of phosphorus, microbes and sediment loss through drains and overland flow.[17] The proposed disposal is to a maximum depth of 10 mm which is shallower than the existing tile drains (500 - 1000 mm beneath natural ground level).

Given the characteristics of the physiographic zone, it can be concluded that the disposal area has higher risk for direct transfer of contaminants to surface waterbodies through subsurface flow. Measures to avoid, remedy or mitigate such effects on surface water quality are discussed as follows.

The primary waterway throughout the property has extensive vegetated riparian margins of up to 2 – 3 metres each side. Vegetated buffers seek to further mitigate the risk of particulate contaminant transportation to surface water by overland flow.

Locations of the major known tile drains are noted on the attached Tile Drain Plan (Attachment B). Contaminant loss from these drains, particularly within the Gleyed Zone, will be minimised by avoiding these areas during periods of high drainage risk, and using sufficiently low application depths of effluent to land which will prevent effluent discharge via the drains, additionally and as assessed above, the low application depths of effluent will enable the nutrients to be assimilated in the top 200 mm of the root zone, (where tile drains are located beneath this) and avoid direct contamination of waterways vie point source discharge of contaminant pathways to receiving surface water bodies. The appropriate timing of

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[17] AEE report prepared for Environment Southland, 2016.

effluent application, enabled by the provision of sufficient deferred storage, avoids application during times when weather conditions are unsuitable for effluent application.

Avoiding application of effluent within 5 days of animal grazing of paddocks and applying effluent only when appropriate soil water deficits exists further avoids the risk of overland flow (or surface runoff).

Although not highlighted as a contaminant of concern, low levels of potassium (K) are of concern to soil health while high levels of are of concern for animal health. As the soils are characterised as having low to moderate reserves in K the addition of effluent high in this mineral will assist with soil health. However, too much K uptake from plants can be detrimental to animal health (if cows ingest too much K in the early lactation period, it can lead to milk fever of hypomagnesaemia). Due to the sufficient disposal area available, no adverse potassium loadings are expected to occur. This would be monitored through nutrient budgeting and soil sampling to ensure sustainable soil health and no adverse animal health effects. This translates to a lower risk for contaminant transfer of K from the receiving soils to surface water ways, as it is assimilated by the receiving soils.

6.2.3 Odour

The effects of odour are most likely to occur from the discharge of farm dairy effluent (FDE) or from the storage of effluent where it may be encountered beyond the boundary of the site. RD Agritech Limited notes that ponds of this size (930 m^3) will stagnate and cause odour, as well as Biological Oxygen Demand problems when applied to soil resulting in increased de-nitrification in the soil, unless oxygenated by means of mechanical stirring, or aeriation of the fluid is conducted.[18] Amongst other things the design of the effluent pond accounted for mechanical stirring as well as the appropriate siting of the infrastructure some 400 metres from the nearest property boundary and 1,000 metres from the nearest dwelling not located on the property. The applicant has also proposed the use of low rate application technology in the form of a Larral Smart Hydrant system which can apply effluent at a rate of between 2 mm and 10 mm/hour[19].

The physical location of the effluent infrastructure coupled with the proposed low application rate Larral Smart Hydrant system and effluent discharge buffers means, there is little risk of adverse effects from odour and spray drift on surrounding land owners and occupiers. As such the effects of odour are avoided, or mitigated through conditions of consent as outlined in Attachment G.

6.2.4 Proposed Monitoring and Mitigation

In accordance with Clauses 6(1)(e) and (g) of Schedule 4 mitigation and monitoring measures to be undertaken to help prevent or reduce actual or potential effects of the conversion and discharge activities have been described in the assessment above, Section 6.6 below and more prominently described in the attached CEP and FEMP (Attachment B).

6.3 Effects of Abstracting Groundwater

Schrader Mains Limited have applied for consent to abstract up to 36,720 L/day of groundwater which is based on a daily volume of 120 litres per cow per day for stock drinking and dairy shed wash down uses. While the abstraction of groundwater is a permitted activity under the PSWLP, it is a discretionary activity in accordance with Rule 23 of the RWPS. The scope of the matters to be assessed are those matters set

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[18] Schrader Effluent Design Report, RD Agritech, Section 4.1, Page 8.

[19] Personal coms. RD Agritech, December 2015.

out in Schedule 4 of the RMA, those matters set out in Rule 23(c) of the RWPS and those matters set out in Appendix A of the RPW.

Under the RWPS the proposed abstraction is from the Waihopai Groundwater Management Zone, which had a total remaining allocation of 94.7 %. However, the PSWLP has reclassified the property as being underlain by the Awarua Groundwater Management Zone. The Awarua Groundwater Management Zone is considered to have a total available primary allocation of approximately 32,290,000 m^3.

6.3.1 Aquifer Sustainability

Under the RWPS, 94.7% allocation of the Waihopai Groundwater Management Zone is available. Under the PSWLP, while the amount allocated is unknown, the applications proposed abstraction of 36,720 L/day and 11,120 m^3/year split over two bores will represent 0.0034 % of the preliminary allocation of the Awarua Groundwater Management Zone, which in negligible. Furthermore, the take is considered a permitted activity under the PSWLP, therefore the effects of the proposed take on aquifer sustainability are less than minor.

6.3.2 Stream depletion

The proposed bore which is to be located near to the dairy shed is approximately 150 m north of the nearest surface water ways being McMillan Creek.

Policy 29 in the RWPS and Policy 23 of the PSWLP requires a stream depletion assessment when the daily average rate of take is more than 2 L/s as takes less than this are expected to have a minor effect on stream flows. As the proposed take is 36,720 L/day, over 24 hours of pumping the rate of take is less than 2 /s (at 0.4 L/s) and therefore does not require a stream depletion assessment.

6.3.3 Effects on Existing bores or wells

The nearest bore to the applicants proposed take is almost 1 km south of the proposed bore north of Bore E44/0321 and the use for this bore is not listed.

Similarly, to stream depletion effect assessed above, the effect on neighbours is likely to be minor. As the proposal seeks to abstract a small volume of water across two bores, in terms of daily volume and rate of abstraction, it is unlikely that the radius of influence is such that interference effects would be experienced by any bore located within a 2 km radius of the property.

Any actual or potential effects are considered to therefore be no more than minor.

6.3.4 Groundwater Quality effects

Information obtained from the ES GIS database indicating the area as having 2007 – 2012 nitrate concentrations of less than 3.5 mg/L (or less than 30% of the maximum acceptable standard for human drinking water).

As the water to be abstracted represents only a small proportion of discretionary allocation, and is a permitted abstraction under the PSWLP water use is unlikely to have any effect on groundwater quality, however for completeness it is noted that any actual or potential effects on groundwater quality are less than minor.

6.3.5 Efficiency of water use

The proposed rate of take is estimated at 120 L/cow/day, which is consistent with Council's recommendation. The applicant is not opposed to the continued monitoring of water abstraction on the property to ensure that use is not excessive. Water abstraction will be metered.

6.3.6 Pump test

A pump test is not required.

6.3.7 Salt Water Intrusion

As the proposed take is of such a small scale, and located a significant distance from the coast with the property at an approximate elevation of 40 m above sea level, the proposed activity will not result in any salt water intrusion.

6.3.8 Monitoring and Reporting

Section 4 of the Resource Management (Measuring and Reporting of water takes) Act 2010 notes that the regulations only apply to water takes greater than 5 litres per second. However, it appears that Environment Southland require the monitoring of all water takes as standard practice (consistent with Policy 42 of the PSWLP) and the take will be monitored in accordance with Environment Southland's standards.

On the basis that allocation of water is available within the relevant groundwater zone and the total proposed rate of abstraction is in accordance with documented 'reasonable use' guidelines, the overall effects of the abstraction of water are considered to be negligible.

6.4 Effects of Pond Construction

Effects of the construction of an effluent storage pond will be no more than minor and temporary in nature. Earthworks will be required to facilitate the construction of the storage pond.

No stock, machinery or mechanical devices will have access to the storage pond, thereby significantly reducing the risk of unintentional damage to the liner. Further assessment, including the height of embankments and placement and orientation of the pond is given in the appended

6.4.1 Location and Design of Effluent Pond

The construction of effluent storage is considered a discretionary activity under Rule of the RWPS, and a restricted discretionary activity under Rule 32 of the PSWLP.

The construction of the effluent pond is to be overseen by RD Agritech Limited who also undertook the design of the pond. The effects associated with the installation of the pond are considered to be less than minor as a result of the scale and duration of the proposed works.

The proposed location of the effluent pond will be a sufficient distance (greater than 50 m) from any surface water bodies and will avoid any actual or potential adverse effects on surface water. The pond is to be located near to the cowshed and will observe the >45 m separation distance from the milking platform. The pond is to be located approximately 400 m from the nearest neighbouring property boundary. The location of the pond and the correct management of effluent will ensure that no objectionable odours occur beyond the property boundary.

The pond will be lined with a synthetic liner to ensure that no effluent is able to leach to groundwater from the pond and will meet the relevant engineering code of practice for effluent ponds.

6.4.2 *Storage Capacity*

The storage volume has been calculated using the DESC in accordance with the Dairy Effluent Design Code of Practice (COP). The DESC takes into account the receiving soils, climate data, number of cows, catchment areas and irrigation methods to determine the appropriate volume of storage. In addition to this, the options considered to reduce the volume of effluent are in the management strategies of the CEP and FMP attached as Attachments B and C.

There will be ample storage in case of pump failure or adverse weather conditions.

The effluent storage pond will be subject to regular visual inspection, including visual observations of the HDPE liner for damage and wear and tear, inspection of the leak detection drain outlet to confirm no effluent is present, and cross checking the volume of effluent applied against the volume accumulated. Frequent inspection will reveal and signs of damage and/or pond leakage, in which case and observed damage will be immediately repaired using appropriate repair methods and experienced liner installers/repairers.

In terms of the risk of pond failure or for the pond to leak, the pond has been designed by a suitably qualified person in accordance with the *Environment Southland Code of Practice for Design and Construction of Agricultural Effluent Ponds* and the IPENZ Practice Note 21 as documented in the report by RD Agritech Limited. The pond design makes provision for a number of measures to mitigate the potential effects of pond failure or leakage which may impact on soil health, including installation of a synthetic 1.5mm HDPE liner, which has a minimum 20-year life.[20]

6.5 Effects of Bore Construction

The proposed bore is to be constructed for the purpose of abstracting groundwater for shed and stock water. The bore is to be used in conjunction with an existing bore located on the property. Overall, the construction of the subject bore is considered to be less than minor.

6.6 Assessment of Alternatives

Clause 6(1)(a) of Schedule 4 requires that a description of any possible alternative locations or methods for undertaking an activity that is likely to result in any significant adverse effect on the environment be included in an assessment of the activities effects on the environment. It is noted that while no significant adverse effects on the environment are considered likely as a result of the proposed conversion, groundwater abstraction and discharge activities, for completeness assessment of alternatives are assessed below.

Clause 6(1)(d) of Schedule 4 of the RMA and Section 105 of the RMA do however require that an assessment of effects includes a description of any possible alternative methods of discharge, including discharge into any receiving environment.

6.6.1 *Land Use*

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[20] Schrader Effluent Design Report, RD Agritech, Section 4, Page 7.

The applicant has considered a number of alternative land uses to the proposed dairy conversion. Including the next best alternative land use that will be adopted in the event that consent for the conversion of the land is not granted. The next best alternative is described as being a 'Specialist Grazier' option which would involve growing 48 ha of fodder crop, the wintering of 900 cows annually and the grazing of 150 yearlings. The 'Specialist Grazier' option could be undertaken under the Operative RWPS as a permitted activity. As the PSWLP allows for intensive winter grazing of up to 50 ha of land without the need to obtain consent within the Gleyed Physiographic Zone, this activity could also be carried out under the PSWLP as a permitted activity subject to the implementation of a FEMP.

In assessing the alternative options for the property, the economic and environmental considerations have been weighed, including the estimated nutrient loss (as an indicator of potential effects on water quality). OVERSEER® estimates losses of 46 kg N/ha/year and 0.5 kg P/ha/year under a 'Specialist Grazier' scenario. This represents a higher nitrogen loss than both the current and proposed land uses, a higher modelled phosphorus loss when compared to current land use, while a slightly lower modelled phosphorus loss when compared to the proposed conversion. However, under the 'Specialist Grazier' scenario the higher land area under crop would increase the potential risks of effects on water quality particularly over the winter months. Economically the specialised grazing option, whilst giving a greater return on investment at 2.6 % than the current operation (1.5 %) is still a significantly lower return that the proposed dairying scenario.[21]

As discussed in Section 4 of this report, there are a number of ancillary activities which the applicant can undertake without the need for a consent. It is noted that there are also a number of permitted land uses the applicant can undertake on their property without the need for a resource consent, such as becoming a specialist winter grazing operation. On a landholding with a total of 110 ha in the Gleyed Physiographic Zone, under Rule 23 of the PSWLP the applicant is able to intensively winter an unlimited number of stock on up to 50 ha of fodder crop between the months of May and September (inclusive) each year.

Considering that under both the conversion and 'Specialist Grazier' options, good management practices that are the same will be required to be adopted, coupled with the fact that under the 'Specialist Grazier' option that more stock (i.e. 1,050 maximum stock numbers compared to 0) will be carried on the property during the highest risk period (1 June – 31 July) in terms of managing effects on water quality the applicant's decision to proceed with the proposed conversion represents the best use of the land both economically and environmentally.

6.6.2 Method of Discharge

There are many effluent disposal methods available currently on the market.

The applicant has opted for Larall Smart Hydrant System which can achieve application depths as low as 2 mm and as high as 10 mm. The applicant considers this method of application the best alternative primarily as low rates of application will enable the soils to assimilate nutrients while not over-applying effluent, to which the associated risks are surface run off or ponding.

Another alternative consider on this property was the use of a travelling irrigator, or the use of pods. Travelling irrigators tends to have non-uniform application patterns and higher application rates and depths, with a higher risk of spray drift. Due to the nature of the soils present in the disposal area, high

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[21] Evidence in Chief A Robertson, Paragraph 12, Page 6.

rate irrigation methods are not recommended. Pods, while they have an ability to apply to low depths and rates, are more labour intensive heavy in that they are required to be shifted frequently and therefore are not preferred on this property for effluent discharge.

The Larall System records the total volume of effluent pumped through each nozzle, and self-monitors the system for insufficient or excess flow to detect blockages and leaks and via a text message signals the system to either turn itself off or notify the farmer by text when the guns need shifting.

6.6.3 Receiving Environment

In terms of discharging to water over discharging to land, we see the discharge of effluent to land as having a lesser effect on the environment than discharging to water. Discharging to land if conducted appropriately enables the reuse of a waste product as a soil conditioner and discharging FDE to an alternative receiving environment (i.e., surface water or tinkered off-site) is considered unsustainable. Nutrients in effluent can be utilised by the pasture and soil. The direct discharge of effluent into water would be more detrimental to the receiving environment, than discharging to land.

The proposed application area includes a 96 ha discharge area. The appropriate separation distances and low applications rates further reduces the risk to the receiving environment, and avoid point source contamination of effluent in waterways, while remaining well above the 8 ha/100 cows' minimum recommendation from the Council's Best Practice Guidelines.

Overall, the discharge of effluent to land is the preferred receiving environment.

6.6.1 Ground Water Abstraction

Alternatives to the abstraction of groundwater include abstracting Surface water, or sourcing Scheme Water, however at present there are no water schemes available to the applicants and therefore either a surface water or ground water take are the best alternatives.

The applicants have considered abstraction of water from the main stem of the McMillan Creek via a surface water pump, being the nearest practicable source for surface water abstraction. However, this surface water abstraction would have an instantaneous effect on the water level of the stream and the water is not recognised as a clean source adequate for milking shed food health standards. Given the small volume of water sought, this option is impractical to the applicant.

The proposed groundwater abstraction split between one existing bore located on the property and one new bore to be constructed on the property is the best alternative. Groundwater can provide a clean reliable supply of water necessary in the operation of a dairy farm. Due to the nature of a dairy farm requiring constant water, and that any effects of the proposed groundwater take have been assessed as less than minor, the abstraction of water from the proposed location is the best alternative.

6.7 Other Matters

Clause 7 of Schedule 4 of the RMA contains additional matters to be addressed in an assessment of effects. These matters are assessed as follows.

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

Consultation with the adjacent and adjoining neighbours to the property has been undertaken, with the written approvals attached to this application. Council must disregard any effect on a person who has given written approval to the application when making an assessment on the environment (Section 95D of the RMA). Any potential adverse effects of the proposal to the wider community would be mitigated primarily through the implementation of best management practices as outlined in the attached FMP.

The proposal to convert the land will give rise to a number of benefits for the applicants, including those which provide for their social and economic wellbeing. Through consultation with Mr Tony Robertson this economic benefit to the applicant has been quantified in the evidence of Mr. Robertson as including an increase in profit from $50,696 per annum under the current land use to $199,137 per annum under the proposed conversion *(pers Comms, 2015)*.

Beyond the benefits gained by the applicant there are also anticipated to be regional and local benefits, including provision of employment opportunities. Currently the Schrader's do not employ any staff on the property, however the conversion of the property would see the employment of a full-time manager along with another part time (or more) equivalent.

The ability for the applicants to convert their property to a dairying operation and continued operation of a dairy farm will enable significant benefits to the applicant to provide for their economic and social wellbeing and moderate benefits in terms of the overall contribution to the region and its economy through increased employment and profitability created directly and indirectly as a result of this proposal.

In terms of the potential effects on cultural values, Te Tangi a Tauira is the Iwi Environmental Management Plan applicable to the Southland Region, an assessment has been made in Section 7.5 of this document.

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

The property is located within Rural Zone as defined in the Proposed Southland District Plan. The Rural zoning sets the precedent for a distinctive rural feel and farming nature of the applicant's property and wider locality. Dairy farming is not uncommon in the area, with a number of dairy farms surrounding the applicant's property, and therefore the conversion of the property to dairy will not be out of keeping with the existing locality. Any effects on the landscape and any visual effects are determined to be no more than minor.

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

The applicant proposes to maintain those areas which are currently planted with vegetation and there will be no physical disturbance to these areas as a result of the proposal. Some shelterbelts will be removed as the property is converted to dairy but it is anticipated that this plant disturbance will be no more than minor, temporary in nature, and not out of keeping with the general maintenance of a farm within the rural zone.

Waterways have been fenced, and all stock will be excluded from these areas. Overall it is considered that effects on plant and animal ecosystems as a result of the proposals, including habitats, will be less than minor.

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:

Under the RWPS, the surface water bodies on the property are classified as lowland hard bed streams with the following values ascribed (from Objective 3):

- Bathing in those sites where bathing is popular;
- Trout where present, otherwise native fish;
- Stock drinking water;
- Ngāi Tahu cultural values, including mahinga kai; and
- Natural character including aesthetics.

A classification system is not employed under the PSWLP to establish values for rivers and streams, however the regional objectives and values in the PSWLP are listed below from Objectives 3, 6, 7, 9, and 11:

- The mauri (inherent health) of waterbodies provide for te hauora o te tangta (health of the people), te hauora o te taiao (health of the environment) and te hauora o te wai (health of the waterbody)
- There is no reduction in the quality of freshwater and water in estuaries and coastal lagoons
- Avoid and reduce over-allocation (quality and quantity) of freshwater
- 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 wellbeing.
- Water is allocated and used efficiently

It is not considered that the activities will have any effect on aesthetic values, as a dairy farm is not out of keeping with the general rural nature of the area, and that the area is historically known for farming activity.

The McMillan Creek is a non-navigable water course and public access would be by permission of the applicant only. A NZ Freshwater Fish Database Search did not reveal the recent presence of fish in the Creek or it's unnamed tributaries. Due to the nature of the take, being a groundwater take, the water take will not have an impact on any recreational fishing near the property. Furthermore, in regards to the discharge of FDE to land, due to the inclusion of separation distances from waterways and efficient and appropriate application of effluent, any potential adverse effects on the tributary of the Waituna Creek and the associated recreational values are minimised, and regarded to be no more than minor. Therefore, no potential fishing and bathing values are to be affected by the proposal.

Special regard has been given to spiritual values, such as mahinga kai, or any other spiritual values associated with the natural and physical resources in the vicinity. It is not considered the proposed activities, being the continued discharge of effluent to land and continued water take for the purpose of dairy operation will have any effect on these values, particularly as the unnamed waterway is not identified as an area where food is gathered.

The proposed dairy platform is generally described as flat farmland which has been significantly altered from its natural state. No scientific values have been identified as being actual or potentially affected by the proposed activities.

The effects on any cultural values of the natural and physical resources of the property, and surrounding area, is assessed above in Section 7.2.4.5 of this document.

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

The discharge of FDE and its effects on the environment have been assessed in the sections above.

Noise emitted from the activities would not be unreasonable in this rural setting.

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

It is not considered that there will be any risk due to natural hazards or the use of hazardous substances or hazardous installations.

6.8 Proposed Mitigation and Monitoring

The applicants propose a number of mitigation measures to remedy potential adverse effects that may arise as a result of the activities described above, these are summarised in the table below.

Table 9: Summary of Proposed Mitigation Methods

Mitigation Method	Purpose
Stocking Rate	Appropriate stocking rates on the property prevents excessive N and P losses, soil degradation and sufficient feed for stock. The property proposes a low stocking rate of 2.97 cows/ha which is within the South Island average[22].
Effluent Storage	Appropriately sized effluent storage enables for deferred application. Effluent will be discharged when there is a soil moisture deficit. This prevents runoff and ponding which may affect water quality.
Irrigation System	Low rate irrigation system (in this case a Larall Smart Hydrant System) are more efficient at applying effluent to land in Southland conditions. FDE discharge is guided by the effluent management section of the FMP which outlines the maximum rates and depths of application of effluent ensuring that these rates and depths are low and applications are timed when soils are suitable to receive effluent.
Buffer Zones	The proposed buffer zones of effluent application to surface waterways, abstraction points and key sensitive areas such as dwellings will avoid potential effects on these areas.
Riparian Buffers and Planting	Acts as a buffer to prevent N, P and sediment runoff into waterways. Riparian planting is proposed to occur in accordance with any required Riparian plan.
Stock Exclusion from Streams	All stock are excluded from waterways via the installation of culverts, and fencing of waterways. This provision protect habitat and prevents stock losses.

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[22] *New Zealand Dairy Statistics 2013-14*. 2014. Web. 4 December 2015.

Mitigation Method	Purpose
Nutrient Management Plan	Sets out quantities, frequency and timing of nutrient inputs including FDE. Furthermore, the application of fertiliser at appropriate times and appropriate quantities as advised by fertiliser experts and indicated by frequent soil tests.
Wintering of Stock	Careful consideration regarding wintering practices has been undertaken, and it has been decided that all stock are to be wintered off the property, which will result in a reduced stocking rate over the winter months from what is currently occurring on the property.
Tile Drains	Grazing and cropping of critical source areas will be restricted to protect wet soils. Low application depths of effluent will also be employed to ensure that nutrients get taken up prior to entering the tile drain network.

The proposed mitigation methods are largely encompassed by the CEP and FEMP, consistent with the management plan objective of Plan Change 13, attached as Attachment B. Proposed monitoring conditions will aid adaptive management through provision of information.

In considering the proposal and its actual and potential effects on the environment, a suite of conditions are proposed which would avoid, remedy or mitigate actual or potential effects. A copy of the proposed conditions are attached as Attachment G.

Overall the proposed conditions of the land use consent for a bore, and construction of an effluent storage pond, and the water permit for the abstraction of groundwater reflect the 'standard' conditions which would normally be attached to consents for these activities. We believe that the conditions are appropriate for managing the activities covered by the relevant consents.

The conditions of the permit to discharge effluent to land and the land use consent for the conversion of the property to dairying are more complex, reflecting the need to carefully manage any actual or potential effects of the proposed activities and to provide greater detail and certainty as to the scale and intensity of the activity that can be carried out under the consents.

The applicant is agreeable to a provision to 'link' the effluent discharge consent and land use consent for the ongoing use of the land for dairy farming, however have not proposed these links as conditions within Attachment G.

The conditions of both the proposed discharge permit (Conditions 10) and land use consents (Conditions 2 and 4 respectively) make provision for the consent holder to prepare and comply with a Farm Management Plan, Conversion Environmental Plan and Collected Agricultural Effluent Plan (which may be included to the FMP) and which are the key tools for controlling how the consent holder will avoid, remedy or mitigate effects. These conditions also direct that particularly the FMP shall be reviewed by a suitably qualified person on an at least annual basis. This ensures that the FMP remains up to date and allows new GMP's to be incorporated where they will improve environmental outcomes. A copy of the FMP is attached as Attachment C, and has been drafted to meet the criteria in the proposed conditions of consent, and to be consistent with Appendix N of the PSWLP.

Condition 11(a) of the discharge permit and Condition 6(a) of the land use consent, and the FMP also direct that the applicant undertake detailed ground and surface water monitoring to assess effects on water quality from the proposed operations, as well as preparing nutrient budgets for the property.

7. STATUTORY CONSIDERATIONS

Schedule 4 of the RMA requires that an assessment of the activity against the matters set out in Part 2 and any relevant provisions of a document referred to in Section 104 of the RMA is provided when applying for a resource consent for any activity. These matters are assessed as follows;

Section 104(1)(a) of the RMA requires, subject to Part 2, a consent authority to have regard to the actual and potential effects on the environment of allowing the activity. The effects of the proposed activity have been assessed in Section 6 above, and overall the effects of the proposed activity are considered moderate to low, and that any effects will be avoided, remedied or mitigated by conditions of consent.

7.1 Part 2 of the RMA

In terms of the considerations required under Part 2 of the RMA, the proposal represents an efficient use and development of a natural resource that will result in significant positive benefits in terms of the applicant's ability to provide for their social and economic wellbeing, while additionally contributing to the regional economy in terms of wages and increased expenditure.

There will however be potential adverse effects that arise, including effects on water quality. It is considered that the effects of the activities have been adequately identified and assessed throughout this applicant and the preceding documentation passed to Council, and that on balance such effects will be at an acceptable level through project design (i.e. dairy farm design parameters), monitoring programs for assessing water quality, the implementation of a FMP for identifying and implementing GMP's and through proposed conditions of consent (Attachment G), all of which will avoid, remedy or mitigate those effects. More detailed discussion of the relevant matters of Part 2 of the RMA is given below:

Section 5 – Purpose

Section 5 of the RMA sets out the principles of sustainable management which in the context of the RMA means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while:

- *(a)* *Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
- *(b)* *Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
- *(c)* *Avoiding, remedying, or mitigating any adverse effects of activities on the environment.*

The effects of the proposal have been assessed overall as ranging from de minimus to moderate across the range of consentable activities, however the proposal will enable the sustainable use of the natural and physical resources (land and water) and will avoid, remedy or mitigate effects thus enabling the activities to be undertaken in a manner which will safeguard the life-supporting capacity of water, soil and ecosystems.

Subsection (b) and (c) as listed above, require the applicant to safeguard the life-supporting capacity of air, water, soil and ecosystems, while avoiding, remedying and mitigating any adverse effects on the environment. We believe that the proposal by Schrader Mains Limited will achieve the purpose of the Act in Section 5. The potential adverse effects are able to be sufficiently avoided, remedied and mitigated by the proposed conditions (Attachment G).

Section 6 – Matters of National Importance

The relevant matters under Section 6 to this proposal are considered to be:

- *(a)* *The preservation of the natural character of the coastal environment, wetlands and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use and development;*
- *(b)* *The protection of areas of significant vegetation and significant habitats of indigenous fauna;*
- *(c)* *The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other toanga.*

Whilst the proposed activities do not directly impact upon the coastal environment, wetlands, lakes, rivers and their margins the wider receiving environment including the Waituna Lagoon means an assessment against this matter is appropriate.

Subsection (a) to (c) as listed above, are important as the property is located within a catchment which flows into the Waituna Lagoon. Subsection (c) is relevant as the Waituna Lagoon is considered to be of cultural significance to Ngai Tahu. Increased nutrient loading is a concern as the Lagoon itself is considered to be in a compromised state in terms of water quality. The proposal to convert the land to dairying will result in an overall reduction in the discharge of nutrients to the property compared to current land use and minimise the risks of water quality from land use activities. On this basis, the proposal will contribute in a positive manner to the matters of national importance identified.

Section 7 – Other Matters

Section 7 of the Act lists a number of other matters that decision makers must have particular regard to when considering an application, it is considered that all subsections are relevant to this proposal;

- *(a)* *Kaitiakitanga;*
- *(b)* *The efficient use and development of natural and physical resources;*
- *(c)* *The maintenance and enhancement of amenity values;*
- *(d)* *Intrinsic values of ecosystems;*
- *(e)* *Maintenance and enhancement of the quality of the environment;*
- *(f)* *Any finite characteristic of natural and physical resources;*
- *(g)* *The protection of the habitat of trout and salmon;*

Section 7 (b) relating to the efficient use and development of natural and physical resources is important considering the sensitivity of the catchment that the farm is located within. The proposal is consistent with subsection 7(e) relating to the maintenance and enhancement of the quality of the environment.

Section 7(a), has been addressed through adherence to the policies and objectives within the Regional Policy Statement, Proposed Regional Policy Statement and Te Tangi o Tauira. The proposed development is considered to achieve Section 7 (a).

Section 8 – Treaty of Waitangi

With respect to Section 8 of the Act, I assess that due care and consideration has been given to the Treaty of Waitangi through the RPS, PRPS and Te Tangi o Tauira, and Sections 6(c) and 7(a) of the Act. Therefore, the proposal is consistent with Section 8 of the Act.

7.2 Statutory Considerations

Documentation as referred to in Section 104(1)(b) of the RMA are;

(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*

These matters are discussed in the following sections.

7.2.1 National Environmental Standards

Resource Management (National Environmental Standards for Sources of Human Drinking Water) Regulations 2007

Regulations 6, 7 and 8 of the Resource Management (National Environmental Standards for Sources of Human Drinking Water) Regulations 2007 (NES) apply to water and discharge permits issued by Regional Councils. The discharge is not in the vicinity of a registered drinking-water supply.

Although not subject to this NES, the discharge area observes a 100 m buffer zone from potable water abstraction points. This buffer distance was developed with involvement of the public health authority to avoid effects on drinking water supplies.

Overall, the proposals offer sufficient mitigating factors that they avoid affecting any registered drinking water supplies that provide 501 or more people with drinking water for 60 or more calendar days each year. Furthermore, the emergency provisions of the NES need not apply as the effects of the activity will not be significantly adverse (Regulations 11 and 12).

As outlined in the attached Technical Assessment, OVERSEER® modelling suggests the average farm modelled nitrogen loss in drainage water will be 5.6 g/m^3 under the proposed dairy conversion. The modelled farm loss of 5.6 g/m^3 is well within the maximum acceptable value in the Drinking Water Standard for New Zealand (DWSNZ) (Ministry of Health 2008).

The discharge is not directly to water and it is accepted that a 100 m buffer zone from potable water abstraction points will apply and be secured through conditions of consent.

7.2.2 Other Regulations

All new consumptive water takes greater than 5 L/s are required to be measured and reported on in accordance with the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010 (Regulations)). As this take is less than 5 L/s, measurement and reporting of this proposed abstraction is not required under the Regulations. However, consistent with Policy 42 of the PSWLP, the applicant is not averse to measuring the water taken, and providing it to Council once annually and upon request.

7.2.3 National Policies

National Policy Statement for Freshwater Management 2014

The National Policy Statement for Freshwater Management 2014 (NPSFM) sets out both water quantity and quality objectives as well as objectives regarding integrated management and provision of reasonable opportunity for Iwi and hapū involvement in overall freshwater management.

Policy A4 has been inserted in the RWPS and further consideration is given below.

The proposal is not inconsistent with Objective A1 which seeks to safeguard the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems, of fresh water and the health of people and communities, in sustainably managing land use and discharges of contaminants. The conversion of the land to dairying and the discharge of effluent is to be undertaken in accordance with best practice guidelines (GMP's), the management of which is outlined in the FMP, and through conditions of consent. The FMP approach allows for management of the discharge so as to ensure that the discharge occurs in accordance with current best practice and in a sustainable manner for the duration of the consent. Effluent is to be collected from the dairy shed and feed pad and discharged to land using a low rate Larral Smart Hydrant System. On which basis, the potential for contamination of water bodies is reduced therefore enabling the objectives of the NPSFM to be met by the proposal.

Objective A2 requires that the overall quality of freshwater within a region is maintained or improved, while protecting the significant values of fresh water in water bodies that have been degraded by human activities to the point of being over-allocated. The Council have not yet identified limits that enable an assessment of whether a waterbody is allocated (or overallocated) in terms of water quality, therefore it is difficult to fully assess the matter of allocation. The applicant's property is located within a sensitive catchment, and whilst the catchment and creek have not been classified as being overallocated, the sensitive nature of the Waituna Catchment is a consideration in respect to whether freshwater can be maintained or improved under the proposal. Having considered all of the information, subject to the inclusion of conditions of consent the activity is considered consistent with Objective A2.

Policies A2, A3 and A4 require the Council to set objectives and limits to assist in the improvements of water quality in water bodies. The Waituna Creek catchment does not yet have water quality limits. Environment Southland are currently working towards setting limits through the *Water and Land 2020 & beyond* project. Environment Southland have released a schedule for rolling out freshwater limits in the Southland Region and they have stated that the Waituna catchment limit setting process will occur in conjunction with the Mataura catchment between July 2017 and 2019 (Environment Southland 2015). Whilst objectives and limits have yet to be set, it is accepted that in the event that consent is granted, any activity at the time of limit setting will be required to meet the stated objectives and limits.

Objectives B1, B3, B4 and C1 of the NPSFM are satisfied as the proposed abstraction of groundwater represents an efficient and reasonable use of the resource that will not result in over allocation.

Due consideration to Te Tangi a Tauira (Murihiku Iwi Management Plan) has been given in Section 7.2.4.5 and consultation with Te Ao Marama Inc and Ngai Tahu has been sought. The consideration of Te Tangi a Tauira and the involvement with Ngai Tahu through the submission process are considered to show consistency with Objective D1 and Policy D1.

7.2.4 Plans and Policies

The operative Southland Regional Policy Statement 1997 (RPS1997), proposed Southland Regional Policy Statement 2012 (RPS2012) and RWPS are the planning documents which are relevant to the proposal.

The relevant provisions of these plans given regard to as follows:

7.2.4.1 Southland Regional Policy Statement

The Southland Regional Policy Statement (SRPS) became operative in 1997, and is subject to a revision via the Proposed Southland Regional Policy Statement (PSRPS) which was publicly notified in 2012. Decisions on the PSRPS were notified on 6 June 2015, however due to a number of appeals of the decision the PSRPS currently remains inoperative[23].

The following gives regard to the relevant matters of the SRPS and, while matters as contained in the PSRPS are not operative, they have some legal effect and for this reason have been given regard to also.

Regional Policy Statement 1997

Mana Whenua Perspective

Relevant objectives include 1.1, 1.2, 1.3, and 1.4 and Policy 1.2.

Recognition of the relationship of mana whenua with their ancestral lands, water sites, waahi tapu and other taonga has been provided for, the extent of which has been determined largely by the direction set in the Ngai Tahu ki Murihiku Natural Resource and Environmental Management Plan Te Tangi a Tauira (2008). An assessment of this document is included in Section 7.6.1 of this report.

Water Quantity

Water quantity objectives of the RPS which are of relevance to this application include 4.1, 4.2, 4.3 and 4.4 and 4.5; whilst the relevant Policies are 4.3, 4.4, 4.5 and 4.6.

The proposal is consistent with these provisions as the volume of water sought represents an efficient allocation of resources, and the taking of water will not result in the over allocation of groundwater.

Water Quality

Water quality objectives of the RPS which are of relevance to this application include 5.1, 5.2, 5.3 and 5.4; whilst the relevant Policies are 5.5 and 5.8.

The proposal is consistent with Objective 5.1 in that the overall proposal, including conditions of consent proposed by the applicant will enable the safeguarding of water quality. A continuation of the alternative land uses (as discussed in Section 6.4) are likely to be inconsistent with this objective despite being permitted activities.

The proposal provides for the mitigation of potential effects on water quality as outlined in the proposed conditions of consent and FMP provided, therefore the application is considered to be consistent with Objective 5.2 of the RPS.

In respect to Policy 5.5 and the assessment of potential cumulative effects, a change in land use subject to the proposed conditions will have no net negative effect on the Waituna Catchment.

Lakes, Rivers and Wetlands

Objectives and policies of the RPS that relate to Lakes, Rivers and Wetlands which are of relevance to the application by Schrader Mains Limited include Objectives 6.1 and 6.2 and Policies 6.1, 6.4, 6.6, and 6.11.

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[23] Environment Southland Website, www.es.govt.nz, July 2016.

As the subject property is located within the Waituna Creek catchment which discharges into the regionally and internationally significant Waituna Lagoon wetland the provisions of Section 6 of the RPS are considered relevant. The application has demonstrated that the proposal to convert to dairying will contribute to the protection of the wetland ecosystem through a modelled reduction in nitrogen loading to the catchment (i.e. from 40 kg N /ha/year to 25 kg N /ha/year). Whilst modelled losses of P suggest an increase, OVERSEER® does not recognise, nor take into consideration many of the GMP's that will be employed on farm to reduce P loss. The Nutrient Management Plan as prepared by Mrs Hunter of Roslin Consultancy Limited, identifies the mitigation methods to be adopted on the application site as having significant potential to reduce P loss. Therefore, the application is not inconsistent with these provisions, including Policies 6.1 and 6.6.

Soils
Objectives 8.1, 8.2, 8.3, 8.4 and 8.5 and Policies 8.1, 8.2, 8.4 and 8.5 are considered relevant.

The proposal by Schrader Mains Limited is consistent with the RPS in respect to matters relating to the use of the soil resource. The method of discharge of effluent, including provision of storage to enable deferred application is in accordance with current best practice guidelines. When compared to the potential alternative land uses, both the current and specialist grazier land use options may give rise to inconsistencies with the Soil Chapter of the RPS compared to the proposed conversion of the land to dairying.

When considering the provisions of the RPS collectively, they set a broad framework for assessment of the proposed conversion of land to dairy. Specifically, in relation to effects on soil health, water quantity and water quality, odour, and cumulative effects.

The proposal is consistent with the relevant provision of the RPS.

Proposed Southland Regional Policy Statement 2012

The following objectives and policies of the PRPS are considered relevant to this application:
Chapter 3: Tangata Whenua; Objective TW.2, TW.3, Policy TW.3 and Policy TW.4
Chapter 4: Water; Objectives and policies for water quality WQUAL.1, WQUAL.2, Policy WQUAL.1, WQUAL.2, WQUAL.3, WQUAL.4, WQUAL.6, WQUAL.7, WQUAL.8, WQUAL.9, WQUAL.10 and objectives and policies for water quantity, WQUAN.1, WQUAN.2, Policy WQUAN.2, WQUAN.6, WQUAN.7
Chapter 5: Rural Land/Soils; Objective RURAL.1, RURAL.2 and Policies RURAL.1, RURAL.2, RURAL.5
Chapter 6: Biodiversity; Objective Bio.1, Bio.2, Bio.3 and Policy Bio.1.

The proposal is deemed consistent with Chapter 3 PSRPS. The relationship of Tangata Whenua with their ancestral lands, water sites, waahi tapu and other taonga has been provided for, the extent of which has been determined largely by the direction set in the Ngai Tahu ki Murihiku Natural Resource and Environmental Management Plan, *Te Tangi a Tauira* (2008).

In terms of an assessment of the application in respect to Chapter 4: Water, the application is consistent with the WQUAL and WQUAN objectives and policies in that the adoption of GMP's as proposed by the applicant will result in the maintenance and potentially the improvement of water quality as modelled by OVERSEER®. In regards to water quantity, the volume of water being sought by the applicant is considered fair and reasonable, and will be less than the permitted abstraction volumes under the PSWWLP and will therefore not result in the over allocation of the groundwater resource.

In regards the Rural Land and Soils objectives and policies, the application is considered to be consistent with the provisions set out in the PSRPS as the application provides for the sustainable use of the rural land resource.

7.2.4.2 Regional Water Plan for Southland

The relevant objectives, and policies of the Regional Water Plan are discussed under topic headings below.

Water Quality

The matters of most relevance include Objectives 3, 4, 8, Policy 1, 4, 6, 7, 13,13A, and 25.
Objective 3 relates to the maintenance and enhancement of water quality. The proposal is considered consistent with this objective. The proposed land use is for a farm system that reduces risks to water quality from the activities on the land.

Objective 4 stipulates that best environmental practices shall be encouraged to improve water quality of surface water bodies. The application by Schrader Mains Limited proposes to adopt GMP's which will result in a reduction in nutrient discharge and potential for overland flow of sediment and contaminants, therefore contributing to an overall improvement in water quality. The GMP's to be adopted represent current best practice and the annual review of the proposed FMP will ensure that new GMP's are adopted as they evolve.

Policy 13A relates to the establishment of new dairy farms whilst recognising the risks to water quality which may arise as a result of the activity. The risks are to be managed through proposed conditions of consent and the adoption of best management practices in the design and implementation of the conversion of the property and during subsequent operation. Most of the risks have been provided for through a combination of farm system development and the infrastructure that will be installed. The balance, are addressed through the land management techniques set out in the FMP.

The policy also provides direction to the council about what should be considered when determining whether or not a conversion should be granted. In my opinion the application is consistent with this policy as the application includes a FMP. In this instance, all the requirements of a CEP are captured within the FMP, which identifies the actual and potential risks and sets out the methods to manage these risks.

Water Quantity

The matters of most relevance in terms of Water Quantity include Objectives 5, 6, 7, and 9, and Policy 14 ,21, 22 ,23, 26, 28, 29, 30 and 31.

Overall the application is considered to be in accordance with the objectives and policies relating to water quantity as the volume of water to be abstracted are recognised as efficient volumes, and the construction of the bore will be undertaken in accordance with the appropriate standards.

Wetlands

The matters of most relevance in terms of Wetlands are Objectives 2 and 4, and Policies 38, 39 and 40.

overall, the application is consistent with the objectives and policies of the RWPS. The proposed conversion would enable the land to be used in a manner which would have lower modelled N losses than the existing land use, and whilst the proposal has higher modelled P losses, OVERSEER® does not account for all the GMP's proposed by the applicant, when modelling P losses[24]. It is expected that the proposal will result in an overall maintenance or improvement in water quality, including those related to wetlands.

Agricultural Effluent

Policy 41 seeks to avoid the adverse effects of agricultural effluent storage ponds. The pond has been designed in accordance with relevant code of practice by an IPENZ certified engineer, which ensures that the pond is wholly consistent with this policy.

7.2.4.3 Regional Effluent Land Application Plan

With regards to the Regional Effluent Land Application Plan (RELAP), it is considered that the proposal is consistent with the objectives and policies of this plan. The applicant is proposing to adopt best management practices in terms of the design and operation of the effluent system, including providing sufficient storage based on the Massey Effluent Pond Calculations to enable deferred application of effluent, the inclusion of a low rate effluent application system, and an effluent disposal area which is approximately four times larger than recommended best practice of 8 hectares per 100 cows.[25]

7.2.4.4 Proposed Southland Water and Land Plan

The Proposed Southland Water and Land Plan (PSWLP) was publicly notified on 3 June 2016, with the initial submission period having closed on the 1 August 2016. Despite this plan not being notified at the time the original application was lodged (i.e. back in 2015), it has been determined than an assessment of the proposal against the relevant objectives and policies of the PSWLP on the basis that is has legal effect from the date of notification, and the direction of Section 104(1)(b)(vi) RMA.

The PWLP sets out its purpose as being to provide direction and guidance regarding the sustainable use, development and protection of water and land resource in the Southland Region.[26]

The most relevant objectives of the PWLP in relation to the proposal by Schrader Mains Limited include Objectives 1 to 3, 6, 11, 13, 17 and 18;

The conversion of the land to dairying, the construction of an effluent storage pond and discharge of effluent to land, as well as the construction of a bore and associated abstraction of groundwater are consistent with the objectives of the PSWLP. The GMP's as outlined in the Attached Management Plans will be adopted and as directed by Objective 18, while the proposal will enable the applicant to provide for the economic and social wellbeing as sought by Objective 2. In regards to Objective 6 the modelled nutrient losses under the proposed dairy conversion show that in terms of N losses, there will be no net reduction in water quality, and in terms of modelled P losses whilst the modelling indicates a potential increase in P losses, the adoption of GMP's (including those methods which are not recognised in OVERSEER®) is not expected to result in a decrease in water quality. As pointed out, in the attached Technical Assessment, it is difficult to quantify water quality effects when this individual site will contribute so little to the overall catchment. Therefore, the assessment has focussed on the opportunities to minimise

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[24] Agresearch. September 2016. Review of the phosphorous submodel in OVERSEER. RE500/2015/050

[25] Farm Dairy Effluent Best Practice Guidelines, Environment Southland, May 2007

[26] Proposed Southland Water and Land Plan (Pg. 7)

the risks of the proposed land use activities. The proposed land use provides the most opportunity to reduce risks to water quality.

The region wide polices of the PSWLP that are of relevance to the proposed application include policies 2, 6, 13, 14, 15, 16, 17, 18, 20, 22, 27, 33, 34, 39, 40, 41 and 42.

The application has considered the relevant iwi management plan (Te Tangi a Tauira) and is therefore consistent with Policy 2 PWLP.

The proposal includes a FMP which outlines the GMP's that the applicant will adopt to avoid, remedy or mitigate any actual or potential effects of the proposed activity. The plan is consistent with Policy 6 for the Gleyed Physiographic Zone. The management techniques set out within the FMP and proposed conditions of consent (Attachment G) manage critical source areas, artificial drains and overland flow also ensuring that the proposal is achieving the purpose of Policy 6.

The applicant has adopted best practice principles in the design of the effluent system, including provision of effluent storage and low rate effluent application systems which in conjunction with the proposed management techniques documented in the FMP will enable the activities to be undertaken and managed so that they minimise potential effects on water quality. The proposal is consistent with Policy 13 as the modelled farm loss of 5.6 g/m^3 mg/L is well within maximum acceptable value for nitrate in the Drinking Water Standard for New Zealand (DWSNZ) (Ministry of Health 2008) and is less than the modelled weighted average nitrogen concentration from the current land use (8.6 mg/L).

The proposal to discharge effluent to land is consistent with Policy 14.

When assessing this application against Policy 16, council must take into consideration the relative weighting of the policy. Additionally, it is noted that key concepts, including 'dairy farming', 'close proximity', 'fully mitigated' and 'over-allocation' of water quality are yet to be defined by ES and therefore any assessment against this policy cannot be completed.

As there is currently no Southland Register of Independently Audited Self-Management Participants, the applicant has prepared a Management Plan consistent with Appendix N of the PSWLP. Riparian planting and appropriate setbacks are to be observed, with all water ways fenced to exclude stock.

The application is consistent with Policies 17, 18, 20 and 22. The effluent management system has been designed by an appropriately qualified person and in accordance with best management practice in terms of low rate application via the Larral Smart Hydrant system and deferred storage. The applicant is also proposing an effluent disposal area exceeding both the minimum 4 ha/100 cows and the recommended best practice of 8 ha/100 cows[27]. All waterways on the property are fenced off from stock, achieving the purpose of Policy 18. In terms of the proposal to abstract water, the volumes of water to be abstracted are an efficient use of the resource, and are within the permitted activity threshold under the PSWLP which signals that the proposal is consistent with Policy 20. Similarly, the permitted activity status of the proposed groundwater abstraction under the PSWLP confirms that the proposal is consistent with Policy 22, whereby the abstraction of water would be an efficient use of the resource.

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[27] Schrader Mains limited will be providing an effluent disposal area the equivalent of 30ha/100cows

The proposal is consistent with Policy 27 as the standards for the construction of the bore and will be given effect to via proposed conditions of consent.

There are no wetlands located within the property, and given the highly-modified nature of the existing environment no land drainage or vegetation clearance within wetland areas is required. In regards the restoration of existing wetlands and creation of new wetlands Schrader Mains Limited propose to explore the installation of tile drain amendments. A number of tile drain amendment options have been specified in the paper by Richard McDowell and David Nash titled *A Review of the Cost-Effectiveness and Suitability of Mitigation Strategies to Prevent Phosphorous Loss from Dairy Farms in New Zealand and Australia.* This paper discusses a number of specific treatment options including the development of 'treatment beds' at the end of tile drains with P-sorptive materials like steel slag or volcanic tephra. These treatments are not well explored in New Zealand compared to other treatment methods.

Other treatment methods referred to as 'edge of field mitigations' can include the use of sorbents such as P Socks which have been found to be an effective removal strategy at low flows. The installation of sediment traps and the development of constructed wetlands are also methods recognised for reducing P loss which will be investigated for use by the applicant. The proposal achieves Policy 33 and 34.

The proposal achieves the purpose of policies 39 to 42. With specific reference to matching monitoring to risk the applicants have set out within the FMP details of monitoring which is proposed to be undertaken to help measure the effectiveness of the GMP's adopted and allow these methods to be improved over time. In terms of the permitted baseline, the assessment of effects and risks of the proposal has not disregarded any effects on the basis of whether they are permitted by the plan.

The proposed conditions of consent and FMP are the primary methods for ensuring that good environmental management practices are documented and implemented by the applicant.

7.2.4.5 Iwi Management Plan

Te Tangi a Tauira is the Iwi Environmental Management Plan for the Murihiku area. This plan replaces Te Whakatau Kaupapa O Murihiku which is recognised in Policy 1.2 of the RPS.

The application is not contrary to the relevant policies of Te Tangi a Tauira, particularly as;

- The provision of buffer zones to water abstraction sites and waterways;
- The application of effluent is proposed to land, which the risks have been assessed in Section 6 above;
- The applicant proposes best practice for land application of managing farm effluent;
- Those areas of tile drains have been identified;
- Those existing riparian margins will be protected;
- Deferred application of FDE is provided for;
- Nutrient loading and stocking rates will be within industry best practice limits;
- The system and management practices are considered appropriate for the risks associated with the receiving environment;
- The applicant is not averse to appropriate potential monitoring conditions; and
- The adoption of best management techniques in association with the conversion and subsequent operation of the property as a dairy unit.

With regard to Policies 3.5.14.17 and 3.5.1.17, the consent periods proposed are less than 25 years.

7.3 Other Matters

Under Section 104 (1)(c) Council must also have regard to

> *any other matter the consent authority considers relevant and reasonably necessary to determine the application*

7.4 Section 105 of the RMA

In addition to the matters in Section 104(1) of the RMA, a consent authority must have regard to the following matters as specified in Section 105 of the RMA if an application is for a discharge permit:

(a) The nature of the discharge and the sensitivity of the receiving environment to adverse effects; and
(b) The applicant's reasons for the proposed choice; and
(c) Any possible alternative methods of discharge, including discharge into any other receiving environment.

The proposal involves the discharge of effluent to land within a sensitive catchment, however the effects on the sensitive catchment are minimised when the discharge is carried out in accordance with the proposed conditions of consent (Attachment G). The discharge can be undertaken in a manner which avoids contaminants from entering water through controls on application method and conditions of consent, including the adoption of best practice management techniques as outlined in the Farm Management Plan, a copy of which is attached as Attachment C.

As discussed previously within this application, in respect to OVERSEER® modelled phosphorous losses that "established riparian margins and management of critical source areas (such as swales) will provide the largest benefit on this property in regards to mitigating effects of the dairy conversion. Laneway management and amendments to bridges will also assist in reducing losses from non-block sources (i.e. other sources). There is also the opportunity to explore the practicality of putting in place tile drain amendments on the major tile systems (approximately 3) to run drainage outflow into bigger zones prior to entering the waterway. These measures are not modelled through OVERSEER®. Reductions in P loss will be significant although difficult to quantify.

The applicant's reasons for the proposed discharge are multi-faceted. Firstly, there is a direct benefit to the property through the return of nutrients to land as a method for improving fertility, and secondly the discharge of dairy shed effluent to land is considered to be the best method for avoiding adverse effects on water as might otherwise occur in the event that the discharge was directly to water.

In this case the alternative discharge options will either result in a worse environmental outcome (discharge to water) or they are not practicable (trucking of effluent offsite), and they transfer risks to another receiving environment.

In conclusion, the requirements of Section 105 of the Act are met having had regard to the attached technical assessment, proposed mitigation and monitoring, and the matters set out in Section 105 (1) (a) – (c).

7.5 Section 107 of the RMA

There are no matters under Section 107(1) of the RMA that would require the consent authority to decline the applications for a discharge permit.

7.6 Summary of Statutory Considerations

Having assessed all of the matters above, it can be said that the application is largely in accordance with the relevant policies and objectives of the documents as set out above, and that having regard to all the matters under Section 104 that the proposal achieves the purpose of the RMA. Subject to conditions of consent any effects of the activities will be avoided, remedied or mitigated.

8. DURATION, LAPSE AND REVIEW

Sections 123 and 123A of the RMA set out the duration period of resource consents. Resource consent for a land-use may be granted for an unlimited duration while resource consent to take and use water may be granted for a term not exceeding 35 years.

The application for land use consent to convert to dairy is sought pursuant to Section 9 of the RMA and is therefore subject to Section 123(b) of the RMA with the period of consent being unlimited. There are no particular considerations required with regard to the term of consent for this activity which have not already been assessed above in Section 6 of this report.

Consent durations of 15 years are proposed for both the applications for Discharge and Water Permits. Special consideration is given to Policies 14A and 43 of the RWPS in terms of determining the duration, inspection and audit requirements of Discharge and Water Permit. The provision of a 15-year consent durations will provide for the 5-year lapse period of the proposed land use consent to convert to dairy as it is likely that the conversion will not occur for a couple of years. The proposed durations for water permits and discharge permits will enable the applicants the time to appropriately set up the dairy conversion without compromising the clock running out on the other consents required to operate the dairy farm. Furthermore, it is noted that in order to give effect to the water permit and discharge permit, a dairy farm must be established.

The duration sought for the Water Permit is considered to be consistent with Policy 14A particularly given the low-level scale and nature of the proposal and its actual or potential effects on the Awarua Groundwater Management Zone. This term of consent has also taken into consideration the need for a secure supply of water to efficiently operate the dairy shed and effluent system. The proposed duration is also consistent with less than 25-year duration (as preferred under the Iwi management plan).

Durations for the bore consent, and land use consent to construct an effluent storage pond are 5 years.

Standard review conditions, consistent with Section 128 of the RMA are proposed within Attachment G of this report.

8.1 Policy Assessment

With regard to consent duration and inspection and audit requirements, special consideration has been given to Policy 14A (Water Abstractions) and Policies 31A (Discharge Permits) and 43 (Farm Dairy Effluents) of the RWPS. Policy 14A states it was formulated drawing from central government guidance and case law. Whilst not specifically identified, it is expected that Policies 31A and 43 equally implement those matters within central government guidance and case law whilst applying a regional direction. Consistent with the PSWLP consideration of Policy 40 is also provided. As such, these policies are considered a comprehensive and regionally relevance doctrine for the consideration and implementation of appropriate consent duration.

Extent and nature of potential adverse effects of the activity

The extent and nature of the actual and potential adverse effects of the activities were assessed in Section 6 of this document and concluded to be no more than minor.

Certainty of potential adverse effects and potential risks of the activity

It can be concluded with some certainty that the potential adverse effects and risks of the activity will be no more than minor, and over all the proposed dairy conversion will be within the expected range of a dairy farm, as compared to the surrounding land uses. Potential adverse effects have in the first instance been mitigated by appropriate management techniques on farm followed by contingency planning, ongoing monitoring and reporting in an auditable format.

Level of council knowledge of the water resources of the area

There is a reasonable amount of knowledge of the receiving environments which has been provided in the Technical Assessment attached. This information is publicly available and is mostly from Council sources. Council hold a significant level of knowledge regarding the underlying Groundwater Management Zone, the receiving soils and nearby Waituna stream, with only continued knowledge and research of Southland and the site being undertaken in the form of the proposed physiographic units and future catchment specific studies.

Relevant Tangata Whenua values and Ngai Tahu Indicators of Health

The application has been assessed as consistent with the relevant tangata whenua values as outlined in the iwi management plan, with particular regard to the proposed consent duration being less than 25 years.

The allocation sought, particularly the proportion of the resource sought;

Overall the proportion of groundwater sought is estimated at 0.0.42 % of the available discretionary allocation for the Awarua Groundwater Management Zone, and is a permitted activity under the PSWLP.

The duration sought by the applicant, plus material to support the duration sought

The duration sought by the applicant is 15 years, the material contained within this report supports the duration sought.

Permanence and economic life of the activity

Commodity market influence is always a factor in the permanence of individual dairying units, hence why effluent discharge activities are often considered to have semi-permanent economic life. The economic life of the discharge is firstly dependent on the granting of a consent to convert their land to dairying. Should conversion consent be granted, the permanence of the proposed dairying operation and associated activities should be inter-generational and the discharge is a very necessary component within this. Furthermore, the permanence of the economic life of the activity requires resource consents be granted from the Council for a reasonable duration.

Capital investment in the activity

Overall, capital investment of the conversion and associated activities is significant and has been analysed under a certain expectation of income to be generated from the venture. Significant investment has been required just to get to the point of making application with expenditure on professional services, including business feasibility studies, nutrient advice, water quality and policy and planning assessments. The new infrastructure, including a new dairy shed, effluent storage tank(s) and irrigation systems, is in the order of millions of dollars.

Overall the level of capital investment is high, and over and above that which would be required to meet standard conditions of consent.

Monitoring and review requirements in consent conditions

The applicant has proposed to undertake an array of monitoring, much of which are best management practices which go above and beyond regulatory measures as is particularly consistent with Policy 39 of the RWPS. On site monitoring and the provision of contingency plans in the CEP and FMP are extensive and it is noted that a specific FEMP section is also provided. Furthermore, as provided for by Section 128 of the RMA, review conditions are proposed in Attachment G of this report.

The desirability of applying a common expiry date for water permits that allocate water from the same resource;

Not applicable

Compliance history associated with the activity; and

As this is a new consent, there is no compliance history associated with this property. There is no evidence to suggest that the applicant will not build a good compliance record in future, in fact their keenness and proactive approach throughout this consenting process, indicates their desire to be fully compliant with Council requirements.

Water quality of the water resources that could be impacted by the activity

The impact of the discharge activity on water quality of the water resources has been provided in Section 6 of this document, and assessed to be no more than minor, with ever possibility to avoid or mitigate potential effects considered.

The timing and development of FMU section in the PSWLP, and whether granting a shorter or longer duration will better enable implementation of any revised frameworks established in those sections.

It is considered that granting a longer consent duration (i.e. 15 years) will better enable implementation of any revised framework establish in the FMU section of the PSWLP, as Council will be able to review all consents in the Mataura and Waituna catchments collectively, which will serve to better implement any limit setting process.

With regard to the proposed discharge, comprehensive consideration and assessment in accordance with Policy 31A of the RWPS has been given throughout the Assessment of Environmental Effects in Section 6 of this report. The relevant risk factors have been identified, and the proposal is consistent with a level of management which matches the level of environmental risk identified to ensure that any effects of the discharge activity are mitigated, remedies and avoided.

In conclusion, due to the low level of environmental risk of the proposed activities on the property a substantial value of investments on the recent purchase of the property, and a general history of full compliance, 15year durations of consent are considered appropriate, and will allow a common expiration date.

A 15-year consent duration is an appropriate mitigation for the proposed activities, review conditions are not opposed, is fully consistent with the relevant council policies and procedures and therefore there is no reason why a 15-year consent duration would be inappropriate.

9. CONCLUSIONS

The applicant proposes to convert their property at Seaward Downs (514 Rimu Seward Downs Road) to dairying. In order to facilitate this, a bundle of consents, are sought from ES including:

- Land use consent for new dairy farming;
- Land use consent for the use of land for dairying;
- Land use consent to construct a bore;
- Land use consent to construct an effluent storage pond;
- Discharge Permit to discharge dairy shed and standoff/feed pad effluent to land; and
- Water Permit to take groundwater for dairy shed and stock drinking purposes.

The application includes an assessment of effects (AEE), a CEP and a FMP meeting all necessary requirements for an application to be deemed complete. It is expected that actual or potential adverse effects generated from the proposed activities on the environment can be avoided, remedied or mitigated to the extent that they are considered to be no more than minor.

The proposed activities are consistent with the requirements of the RMA and relevant statutory requirements.

Accordingly, we therefore look forward to the applications being processed under delegated authority. Hank and Sandra Schrader, on behalf of Schrader Mains Limited, propose to convert their property at Morton Mains to new dairy farming. In order to facilitate this, a number of resource consents are required to be obtained from Environment Southland including a Land Use Consent for New Dairy Farming, a Water Permit, and Discharge Permit to discharge Farm Dairy Effluent. The application includes an assessment of effects (AEE) and a Conversion Environmental Management Plan as is required by Environment Southland and the effects of the activities are considered to be no more than minor or less than minor.

ATTACHMENTS

Attachment A – Certificates of Title
Attachment B – Conversion Environment Plan
Attachment C – Farm Management Plan
Attachment D – Technical Assessment
Attachment E – Dairy Effluent Pond Design Report
Attachment F – Affected Party Approvals
Attachment G – Conditions of Consent

Attachment A – Certificates of Title

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **SL9C/678**
Land Registration District **Southland**
Date Issued 20 August 1990

Prior References

SLA2/68	SLB3/1376	SLB3/1456

Estate	Fee Simple
Area	77.2697 hectares more or less
Legal Description	Section 7 and Section 49 Block II Oteramika Hundred and Lot 1 Deposited Plan 12478

Proprietors

Schrader Mains Limited

Interests

Subject to Section 308 (4) (5) Local Government Act 1974

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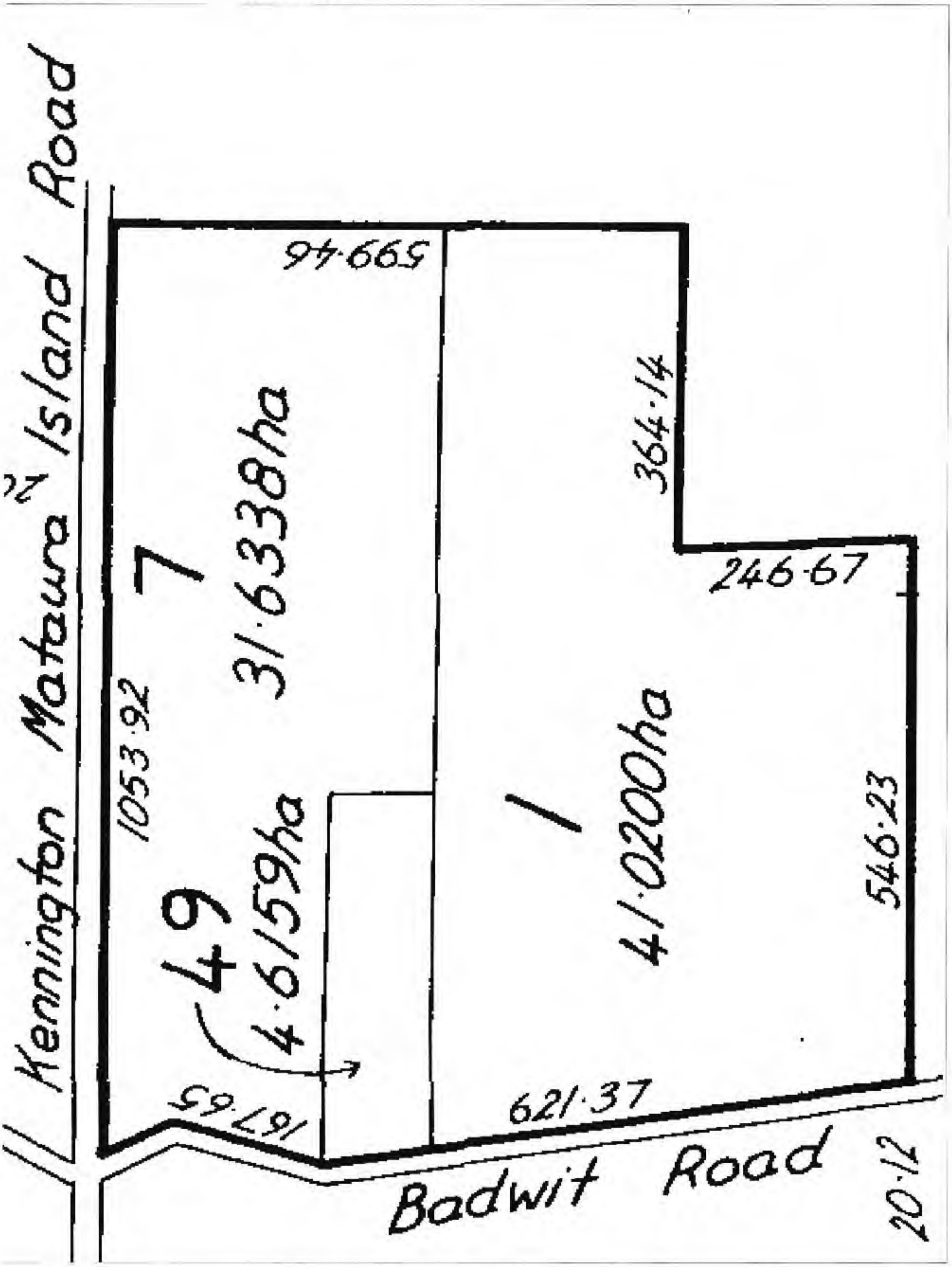
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41.0200ha
546.23
49
4.6159ha
167.65
621.37
Badwit Road
20.12

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **SL9C/679**
Land Registration District **Southland**
Date Issued 20 August 1990

Prior References
SLB3/1456

Estate	Fee Simple
Area	33.4876 hectares more or less
Legal Description	Part Section 5-6 Block II Oteramika Hundred

Proprietors
Schrader Mains Limited

Interests

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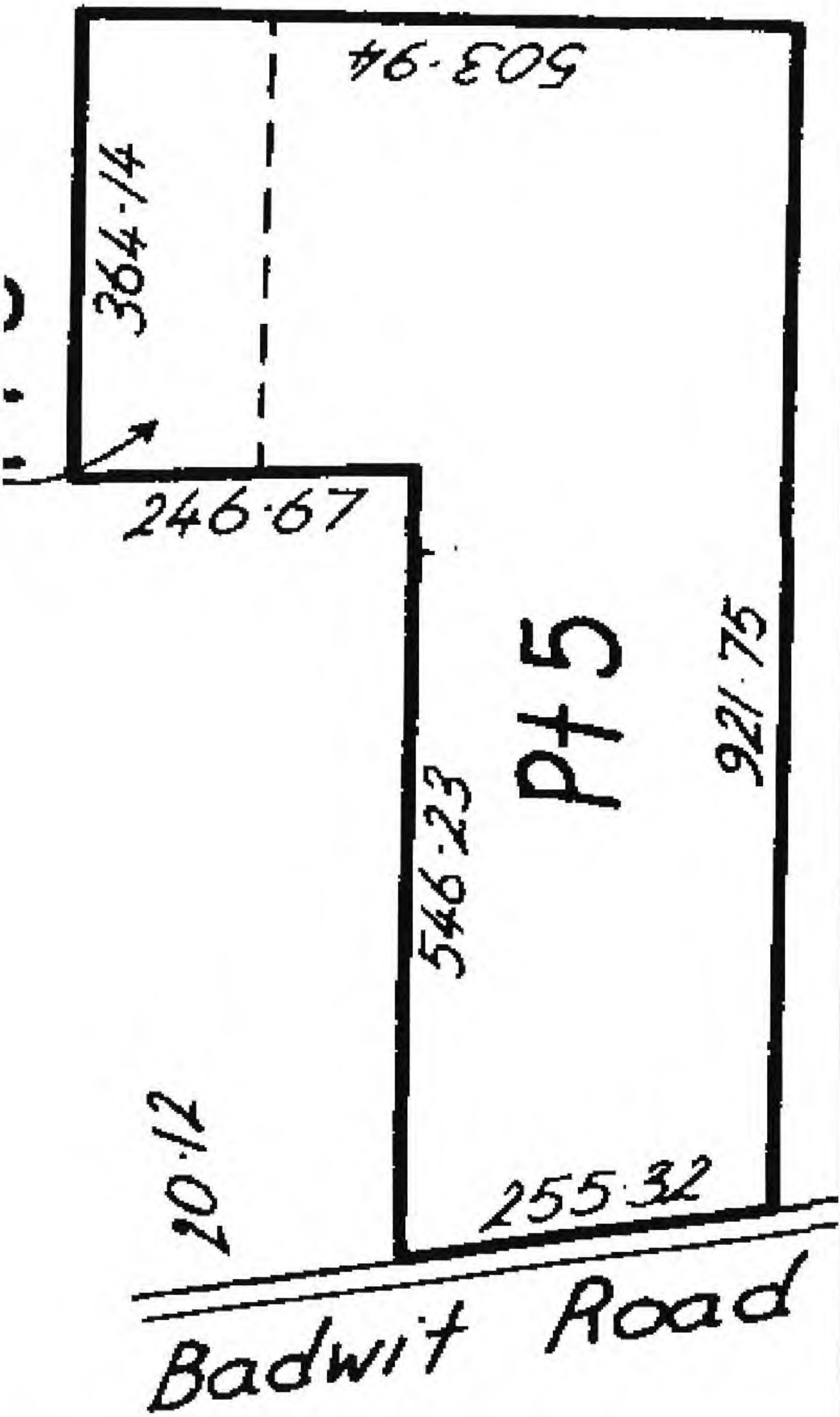
Identifier **SL9C/679**



Attachment B – Conversion Environmental Plan

LANDPRO
Make the most of your land

Conversion Environmental Management Plan

For Schrader Mains Limited

Version No.	**Date**
1	January 2017
Prepared by:	**Position:**
Landpro Limited	-
Approved by:	**Position:**
Hank and Sandra Schrader	Landowner

Approvers signature:

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Prepared For

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Document Control Statement:

To ensure this Conversion Environmental Management Plan (CEMP) is kept up-to-date and that the most recent version is used, its distribution and revision will be controlled. The farm owner will:

- manage the master copy and any other paper or electronic copies of the CEMP
- keep a summary of updates, versions and dates and distribution lists
- ensure CEMP updates are distributed to all relevant staff
- ensure any out-of-date copies are discarded when updates are distributed

Contents

1. Introduction

Hank and Sandra Schrader, on behalf of Schrader Mains Limited, wish to establish a new dairy farm. The property currently operates as a dairying grazing (young stock and cow wintering) and beef unit. The conversion is to occur within five years of granting of consent with the dairy farm milking a maximum herd size of 306 cows.

1.1 Scope of Conversion Environmental Management Plan

This plan has been developed to assist with achieving compliance with the relevant rules and objectives detailed in the Regional Water Plan for Southland (RWPS) in association with the conversion of the land to dairying. This plan also seeks to set out how compliance with conditions of resource consents is to be achieved.

The following aspects of the operation are covered by this CEMP:

- Description of Site, Climate & Topography
- Description of Farming Operations & Systems
- Nutrient Management
- Effluent Management
- Water Quality
- Biodiversity
- Soil Management
- Consent Compliance

This document is a 'living' document and will be subject to annual review and ongoing changes by the farm owners to ensure that it is up to date and reflects both on farm and best farm practice.

2. Site and Environment

The property is located at 514 Rimu Seaward Downs Road, Waituna, as shown in Figure 1 below.

Figure 1: *Location of property (Source: LINZ Topo 50 Series)*

Property Owner:	Schrader Mains Limited
Phone:	(03) 239 5528
Email:	027 408 0962
Milking Platform Area:	110 hectares
Effective Area:	103 hectares
Wintering:	No stock wintered on farm between 1 June – 31 July
Climate	- Average annual rainfall – 1152 mm/year - Mean annual temperature – 10.1°C - Daily rainfall pattern setting of 731 to 1450mm, none to weak - Mean annual PET of 775mm (moderate variation)
Topography	Flat contour
Description of waterways on property	The main waterway that flows through the property is the McMillan Creek. The property is in the Waituna Creek catchment, which drains directly into the Waituna Lagoon.
Existing vegetation (introduced and native)	Exotic and native plantings are present on the property.
Soil types	Majority of the soils found on the property are Woodland soils, with Dacre soils being located around the stream flowing through the property.
Groundwater Resource	Waihopai Groundwater Management Zone / Awarua Groundwater Management Zone

3. Dairying Operation

Stocking Regime

Mixed Aged Cows:	306
R2's:	25% replacement rate
Calves:	25% replacement rate. From 1st August to 1st December
Other stock:	Not Applicable
Stocking rate:	2.97 cows/ha (effective area)

Feeding System

Supplementary Feed Bought:	225t DM baleage (fed across pastoral blocks)
Crops:	2 ha kale (yield 12t DM/ha) grazed by cows
Typical Grazing Programme:	Rotational, use of restricted grazing practices during high risk periods.

4. Agricultural Good Practices

As part of converting the property to dairying there are a number of 'Agricultural Good Practices', which where relevant are already being utilised on the property and will continue to be utilised or implemented across the farm to minimise potential effects associated with the conversion of the land to dairying. Good practices will include:

- Fertilisers applied according to code of practice for fertiliser use.
- Use of a fertiliser management system and account for all sources of nutrients including applied effluent (nutrient budgeting).
- Fertiliser evenly applied.
- Effluent applied evenly.
- Crop, cultivation, nutrient inputs, yield record kept.
- Supplement and feeding out management.
- Winter grazing management.

Tier 1 and 2 AgResearch mitigation practices will also be implemented on the property. These are discussed throughout the management plan and included in the table attached below for ease of recognition.

AgResearch Tier 1 and 2 Management Practices

Environment Southland requires that Tier 1 and 2 Management Practices as outlined in the AgResearch report, *Potential Nitrogen and Phosphorous Losses from example farms in the Waituna Catchment: Sources and Mitigation. Robson. M Monaghan, R McDowell* are incorporated into the Conversion Environmental Plan for dairy conversions. To make it easier for consent processing staff to identify the farm management practices, the table below outlines those Tier 1 and 2 Practices to be implemented on the farm.

Table 2: *Tier 1 and Tier 2 Management Practices*

Management Practice	Tier	Implemented Y/N	Explanation
Nutrient Management Plans	1	✓	A Nutrient Management Plan has been prepared for the property which includes all nutrient inputs and outputs. This nutrient management plan will guide decision making with regard to fertiliser applications and will be aided by regular soil testing.
Optimum soil test P	1	✓	Soil testing will be undertaken regularly. This will provide information on the nutrient status of the soils. An Optimum soil P test will ensure knowledge of the P status of the soils which is a good indicator of soil health and environmental impacts as well as aiding good management decisions with respect to fertilizer use.
Stock exclusion from streams and wetlands	1	✓	Waterways will be fenced. This will prevent point source pollution and stock damage to the banks of waterways. Riparian planting will be undertaken which will further mitigate the effects of overland flow, stabilise the banks of the waterways and provide shading. The riparian planting will take place in three stages over a five year period, see riparian management plan attached as Appendix E.
Tracks and lanes sited away from streams and lane runoff diverted to land	1	✓	Tracks and lanes will be sited away from waterways where possible with the camber directing runoff to land to ensure no overland flow of effluent into waterways.
Sediment traps	1	×	Not considered suitable for this property.
Facilitating the development of natural wetlands	1	N/A	No wetland area is associated with this property.

Management Practice	Tier	Implemented Y/N	Explanation
Wintering cows in herd shelters	2	×	No herd home is proposed.
Wintering in herd shelter + Restricted grazing of pastures in autumn	2	N/A	No herd home is proposed, although restrictive grazing will be undertaken.
Limiting N Fertiliser use	2	✓	Fertiliser use will be limited to that required to achieve production without having adverse environmental effects. The Nutrient Management Plan will guide the use of Nitrogenous fertilisers.
Substituting N fertilised pasture with low N feeds	2	×	The farm will be run as a predominantly pasture based system.
Tile drain amendments	2	×	No tile drain amendments are required. A tile drain map is included in the CEMP, Appendix A.
Use of Nitrogen inhibitors	2	×	The use of nitrogen inhibitors may be investigated in future. At this stage N inhibitors are not available for use due to food safety and market concerns.
Grass buffer strips	2	✓	Grass buffer strips will be utilised prior to any planting of riparian margins that may occur that have not already been planted. Grass buffer strips are known to perform stabilisation and erosion mitigation functions as well as overland flow mitigation.
Constructed wetlands	2	N/A	Not applicable
Wintering off stock	2	✓	All stock are to be wintered off the property
Alum to pasture	2	×	This mitigation practice is still in research stages and therefore not viewed as appropriate or cost effective at this stage. May be investigated in future.
Alum to grazed cropland	2	×	This mitigation practice is still in research stages and therefore not viewed as appropriate or cost effective at this stage. May be investigated in future.
Strategic winter grazing of forage crops	2	✓	Strategic grazing during high risk months.

Management Practice	Tier	Implemented Y/N	Explanation
Restricted grazing of cropland	2	✓	Stock will be restrictively grazed using temporary electric fences sections of cropland. Grazing will occur in accordance with best practice, grazing will be undertaken towards waterways and swales.
Restricted grazing of pasture	2	✓	Stock will be restrictively grazed using temporary electric fencing of sections of pasture when appropriate.
Low solubility P fertiliser	2	×	Fertilizer use will be guided by the nutrient management plan with advice from a nutrient management advisor and farm consultant.

In addition to these mitigation practices proposed in the above table water is to be recycled to reduce the volume of water taken and effluent.

5. Nutrient Management

Nutrient management is a key component to ensuring good on farm environmental practice. The farm will operate under industry best practice guidelines and in accordance with the Nutrient Budget and Nutrient Management Plan, attached as Appendix B. The Nutrient Management Plan and Budget will be reviewed and updated on an as required basis, but not less than an annual basis guided by a fertiliser representative and nutrient management advisor. The nutrient budget has been prepared using OVERSEER® 6.2.3 which is the latest version of the model.

Nutrient management requires knowledge of the nutrient status of the soil resource and pasture requirements to be effective, and to achieve the desired environmental and production outcomes.

Regular soil tests will be undertaken to establish the nutrient status of the soils. Soils should be at nutrient levels which avoid any adverse effects on the environment but maintain good pasture production and animal health, by ensuring that the soils are suitable for optimal plant nutrient uptake.

Areas which are receiving FDE will be carefully managed to ensure nitrogen loadings are at acceptable levels and are compliant with any conditions imposed by resource consents. The annual effluent nitrogen loading rate shall not exceed 150kg/N/ha. Effluent will be applied utilising low rate application. Effluent management is discussed in the next section of the CEMP.

Levels of potassium will also be monitored to ensure good animal health outcomes, particularly with respect to the effluent block. For more information regarding the nutrients associated with the subject property please refer to Appendix B of the CEMP for the Nutrient Budget which has been prepared by Miranda Hunter of Roslin Consulting Limited.

6. Effluent Management

The effluent management section of the CEMP is designed to be a working document where consent conditions and changes to best management practice can be added or amended over time.

Effluent management will be critical to ensure that effects on the environment are no more than minor particularly considering the soil types on the farm which have vulnerabilities to waterlogging and slow subsoil permeability. Active management of effluent and nutrient budgeting aided by up to date soil moisture monitoring technology will ensure that the risks of leaching and overland flow are managed and mitigated appropriately. The discharge of FDE to land requires resource consent from Environment Southland, therefore any discharge will be governed by conditions, which must be met at all times.

Being a new conversion, the effluent disposal system will be designed for purpose and will be a new installation. In this case the effluent will be disposed via a low rate Larral Smart Hydrant irrigation system. Areas for discharge will be set up to ensure that effluent is only applied to the paddocks intended and ensure that buffer setbacks from waterways and exclusion of laneway areas are observed.

One of the most critical components of effluent management is staff knowledge and training which shall include an understanding and working knowledge of the conditions of consent for effluent discharge and best practice guidelines for effluent management. A 'Staff Training Guide' has been included in this CEMP and should be introduced to staff at the beginning of each season to inform new staff and provide opportunities for revision.

FDE will be collected and stored in an above ground tank. Effluent will then be pumped and irrigated onto land in accordance with industry best practice and according to conditions of consent. The volume of effluent produced from 306 cows based on the Environment Southland guideline of 50 litres/cow/day is 15,720 litres/day.

The total FDE disposal area is 93 ha available to receive effluent from the intended future herd size of 306 cows. The following buffer zones will apply to the effluent disposal area:

- 20 m from any surface waterbody or artificial watercourse;
- 20 m from any neighbouring property boundary;
- 200 m from any residential dwellings not located on the property; and
- 100 m from any water abstraction point.

6.1 Storage Specifications

The effluent storage pond size has been calculated according to the Massey University pond calculator and will total 834 m^3, however a storage pond with an operational capacity of 930 m^3 is to be installed. The Massey University Effluent Pond Storage calculator takes into account a number of variables including thirty years of climate data, catchment areas, application rates, number of cows, and the suitability of soils to apply effluent. The use of the Massey Calculator is considered industry best practice and forms part of the Dairy NZ Effluent Design Code of Practice.

The pond size includes capacity for a potential increase in rainfall, and a maximum herd size of 320 cows, which is greater than the peak milking herd of 306 cows. The reason for the additional storage is to allow the discharge of effluent when there is a soil moisture deficit and when the receiving environment is appropriate. The effluent storage pond will be located near the dairy shed in a location recommended by the engineering designer to fit in with shed construction, ensure maximum efficiency of pumping and that food safety regulations are met.

6.2 Effluent Specifications

Discharge from the effluent pond is designed to discharge year round, depending on underlying ground conditions. The tank has been designed to have sufficient storage to allow deferred irrigation which ensures that effluent irrigation only occurs when there is a soil moisture deficit.

Effluent will be applied to the paddocks via the irrigation system at a minimum rate of 2 mm by a low rate Larral Smart Hydrant system. The effluent system will be managed according to conditions. Low rate systems are preferred as they are known to have better environmental outcomes than high application systems.

The irrigation system will be controlled by the farm manager and staff to suit the conditions and visual inspection will occur over the proposed application area both before and during application to ensure conditions are suitable for discharge. Under no circumstances will FDE be applied when surface water is ponding, or during and post (12 hours) heavy rainfall intensities of greater than 5 mm/hour.

During unsuitable conditions the irrigation system will be inactive with daily FDE stored in the pond for discharge at a more suitable time. Irrigation will occur on every available day until the nutrient limit for the soil is reached or the maximum depth of application is reached. Prior to the application of effluent to land a soil moisture monitor will be used to determine soil moisture levels. The closest Environment Southland monitoring station is located on Lawson Road, Waituna. This will determine the appropriate application rate and depth for the irrigation system to be used. Effluent will be applied as follows:

- At a maximum depth of each individual application of effluent to land will be not more than **20 mm**;
- The maximum rate of application will be not more than **2 mm/ hour**;
- The maximum loading rate is consistent with the standard nutrient loading limit of not more than 150 kg N/Ha/yr;
- Application of FDE will be delayed until soil moisture conditions are suitable and does not occur when the risk of surface runoff is elevated (i.e. during rainfall events);
- Effluent application will not occur on soils that are at or above field capacity.

6.3 Effluent Treatment

The treatment of effluent is not proposed or considered necessary.

6.4 Reducing Effluent

All practicable steps will be taken to reduce FDE generation on the property. The following general guidelines as outlined by Dairy NZ will be adopted;

- Minimise water use – the applicant will utilise a green wash system.
- Clean stone trap regularly
- Maintain and Service all parts of the effluent system
- Ensure application conditions are acceptable prior to beginning application.

By reducing the amount of effluent and sludge at the source, i.e. the dairy shed; it can be expected that less effluent will require disposal in the long run. Effluent can be minimised as follows;

- Treat the herd gently to avoid upset
- Reduction of cow stress levels by being quiet and even tempered
- Reduction of the potential for loud and or unusual noises
- Reduction of situations cows are not accustomed to
- Keep use of hoses to a minimum and ensure efficient use of water
- Repair leaks immediately and maintain storm water drains
- Recycle water where possible.

6.5 Effluent System Maintenance

Maintenance of the effluent system is essential to ensure that the system is working as intended. Monthly maintenance checks will be undertaken to ensure that all parts involved in the catchment, storage and disposal of effluent are functioning correctly.

The following checks will be undertaken on a regular basis and details recorded:

- Clean stone traps;
- Check the sump is clear of solid material. If necessary arrange to clean out the sump;
- Regularly clear the tank of solids when required (expected to be once every two years);
- Check nozzles are clear and in good working order; and
- Check effluent pipe is in good working order and does not have any leaks.

Any matters requiring follow up shall be followed up immediately. A monthly check sheet is attached as Appendix C.

6.6 Effluent System Operation

Prior to the operation of the effluent system, the following steps shall be undertaken;

- Check soil moisture levels. Effluent **MUST NOT** be discharged when the soil is at field capacity. Soil Moisture will be tested prior to the application of effluent.
- Check wind conditions to ensure that effluent can be discharged without resulting in spray drift and odour beyond the boundary of the property.
- Set timer clock on the effluent pump for required duration i.e. One hour.
- Check that the effluent pump has come up to optimum operating pressure.
- Check all of the nozzles are unblocked.
- Check the effluent line for any leaks.
- During operation perform regular checks to ensure that the discharge is not resulting in ponding or surface run-off. If surface ponding is occurring, switch the effluent system off, and re-check soil moisture levels.
- Record details of the effluent disposal duration and location and keep records for future reference (record these details on the form attached as Appendix D).

6.7 Effluent System Monitoring

Once the effluent system is operational and the steps outlined in Section 6.6 have been carried out the effluent system shall be monitored during and after application to ensure that there are no leaks, and there is no surface ponding or run-off.

The effluent storage pond shall also be checked regularly.

Monitoring shall also occur as detailed in the conditions of resource consent and as discussed in Section 9.

6.8 Effluent System Training

The efficient operation of the effluent system in accordance with the conditions of consent requires staff to be informed and aware of the conditions of consent (including this CEMP), and the steps required to be undertaken when operating the system.

The manager will be responsible for ensuring that all staff are trained in the operation and maintenance of the effluent discharge system, and for training new employees. A guide to staff training requirements is detailed in Appendix E, and shall be completed once training has been provided. Effluent training should be revisited or recapped at the beginning of each season to ensure all staff, new and existing, are aware of consent requirements and responsibilities.

Opportunities for further training to improve effluent management will also be identified and undertaken as appropriate.

7. Water Quality Management

7.1 Description of Surface Waterways

The farm is situated to the northeast of the Waituna Catchment and is made up of mainly flat land, with some sloping land along the waterway that flows diagonally through the centre of the property. The waterway is an unnamed tributary of the Waituna Creek which flows into the Waituna Lagoon. Every three years Environment Southland will clear this stream of weeds and sediment that have built up. The last clearing was in February 2015. This waterway has been fenced and riparian margins have been planted.

Stock crossings are designed in a manner that will ensure no effluent discharges to the stream via overland flows. A silage pad is planned to be installed and will be located a minimum of 50 metres from any surface water body to ensure no overland run off occurs. This pad area is also to be used to stand stock off paddocks and for feeding the cattle.

Silage leachate will be captured and directed through the FDE system. Stormwater will be directed into an appropriate water course.

7.2 Surface Water Quality

Water quality within the Waituna Creek reduces as it travels through the catchment and into the Waituna Lagoon. Land use in the catchment is causing elevated levels of nitrogen and phosphorus in waterways.

The fencing and ongoing planting of riparian margins will have a positive effect on the water quality of the surface waterbodies as stock will be excluded and riparian margins will reduce overland flow as well as the provision of shading and habitat for any flora and fauna species present. There are no surface waterbodies with public recreational values located on the property. Due to the sensitivity of the Waituna catchment management practices which prevent effluent from waterways is very important. Management practices include but not limited to:

- Application of effluent at a low rate;
- Effluent irrigation only to occur when soil moisture deficit occurs;
- Buffer zone of at least 20m from surface water bodies on the property;
- Deferred storage;
- Large effluent disposal area;
- Wintering majority of stock off the property.

All of the above management practices will ensure that the activities undertaken on this property do not contribute to the further degradation of water quality within the Waituna Catchment.

7.3 Groundwater Quality

The property is located within the Waihopai Groundwater Management Zone, which is considered to be susceptible to nutrient enrichment. Groundwater that is sourced from the tertiary aquifers can contain high iron concentrations due to the mudstone and lignite geology[1].

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[1] Source: Environment Southland Groundwater Zone Information Sheet http://gis.es.govt.nz/groundwater/zones/waihopai.pdf

Environment Southland have broadly categorised groundwater resources in the Waituna catchment into three zones[2]: The property is located within the Northern Waituna Zone Zone which covers the northern section of the Waituna Creek catchment (north of Mokotua) and is characterised by thick, stoneless brown soils which buffer groundwater quality from the effects of land use due to cation exchange and chemical sorption processes which are aided by longer mean residence times (months). Shallow groundwater quality in this area shows little impact from land use with the main risk to water quality being from artificial drainage.

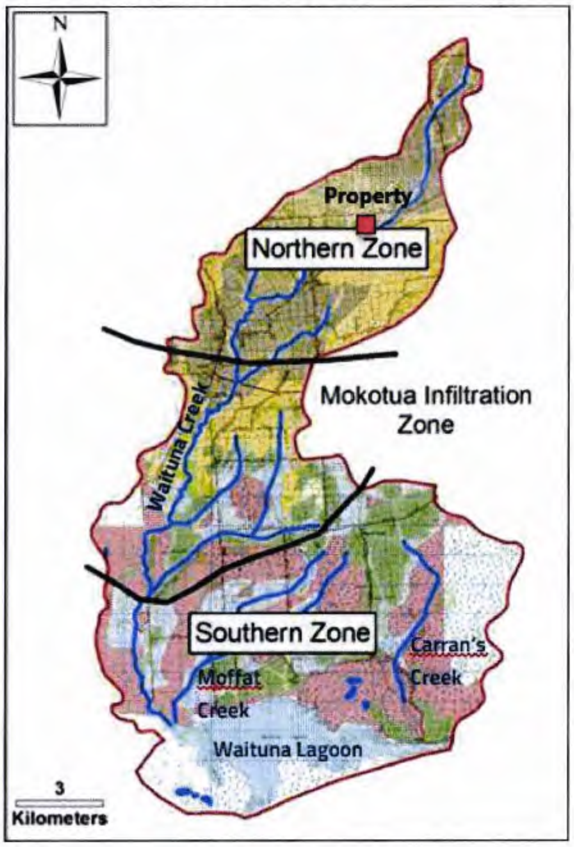

Figure 2: *Groundwater quality zones of the Waituna catchment as defined by natural variation in hydrological and hydrogeological properties, soil and aquifer types and hydrochemical variation [Adapted from: Environment Southland, 2012[7]]*

Due to the sensitivity of the Waituna catchment to the leaching of nutrients resulting in the degradation of water quality the following management practices are recommended, but not limited to:

- Low rate application of effluent;
- Effluent irrigation only to occur when soil moisture deficit occurs;
- Buffer zone of at least 20m from groundwater bores on the property;
- Deferred storage;
- Large effluent disposal area;
- Stock to be wintered off;
- Feed pad for feeding of silage.

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[2] Rissmann, C., Wilson, K., and Hughes, B., 2012. Waituna catchment groundwater resource technical report. Environment Southland publication 2012-04, Invercargill. 93p.

All of the above management practices will ensure that the activities undertaken on this property do not contribute to the further degradation of water quality within the Waituna Catchment.

7.4 Riparian Management

Fencing and Planting

The main waterway that flows through the property is an unnamed tributary of the Waituna Creek. This waterway has been fenced and riparian margins have been planted. Environment Southland's Sustainability Officer Katrina Robertson has been onsite and concluded that the current riparian planting is considered to be sufficient, not further planting is required.

Fences have been constructed to ensure no stock access to waterways on the property. This will ensure that stock cannot enter the waterways and cause point source pollution or contribute to bank collapse. Fences are constructed allowing a minimum of 3m buffer zone from the waterway to ensure a riparian buffer remains between grazing pasture and the waterway.

Temporary Fencing

Any ephemeral waterways which run through the property will be temporarily fenced off from stock to prevent any point source discharges or bed disturbance occurring in these small drains.

Crossing of Waterways

At this stage there are no intentions to construct any new bridges or culverts on the property. If a new bridge and/or a culvert is required it will be done in a manner to ensure that minimal harm to waterways or riparian margins occurs. Stock crossings will be constructed to ensure that no overland flow of effluent occurs into the waterway. Where culverts are installed they should be maintained to ensure they do not block with debris, especially following flood events.

7.5 Water Use Efficiency

The water to be utilised for the dairying activities is sourced from groundwater. At all times water, must be used in the most efficient manner possible. Strategies for minimising water use include;

General

- Check stock water troughs regularly to ensure they are refilling correctly.
- Check water pressure regularly, if pressure is low investigate and eliminate the possibility of water leaks.

At the shed

- Ensure all hoses and taps are turned off properly when not in use.
- When washing down the shed, conserve water where possible while still maintaining cleanliness of the farm dairy.
- Installation of a greenwash system.

Water will be metered to ensure that usage is accurately recorded. Water meter records should be checked regularly to ensure usage volumes are known and within the consented allocation. Records will be available to council if requested.

8. Biodiversity Management

8.1 Pest Management

Regular pest plants and animal species which are to be expected on Southland landholdings are present on the property. Pest management strategies are listed below. There are no known significant indigenous species found on the property.

Table 3: *Pest Plant Management*

Pest Plant	Management Strategy
Thistles, Gorse, Broom	Continuation of the current spraying and grubbing programme. Sprays are not to be used near waterways to prevent chemical pollution of water.

Table 4: *Pest Animal Management*

Pest Animal	Management Strategy
Magpies	Trapping or shooting will be used to control the magpie population.
Hares & Rabbits	Night shooting as required to keep numbers under control.

The above table outlines pest management strategies for the pests which have been identified as being on farm. Other pests which are identified in the general district include Opossums, Ragwort and various species of thistles. Ducks and Spur-winged plovers can also be problematic and while ducks are able to be shot during the duck shooting season only, plovers are not a wildlife species that is protected under the Wildlife Act 1953 and can be captured or killed at any time for any reason.

The Environment Southland Pest Management Strategy outlines a number of pest plants and animals which are to be controlled or eradicated from the region. The farm shall be operated in accordance with the Regional Pest Management Strategy to ensure that all pests are managed or eradicated from the farm. The Regional Pest Management Strategy can be found on the Environment Southland Website.

9. Soil Management

Good soil management is not only beneficial to the soil resource itself, but also to production. The silty soils on the property are known to have vulnerabilities to waterlogging and therefore must be managed accordingly to reduce pugging and overland flow. Winter is a critical time of year for vulnerable soils and the implementation of practices such as standing off and wintering off-farm will ensure the mitigation of any adverse effects which may arise as a result of the continuation of dairying on the property.

The following soil management methods will be implemented:

Table 5: *Soils Management Problem and Management Strategy*

Problem	Management Strategy
Compaction- pugging	Stand cows off on concrete pad or the dairy shed yard where possible in exceptionally wet conditions. Use of back fence breaks as appropriate. Use of heavy machinery to be avoided in very wet conditions. Minimum tillage to be used where appropriate.
Wintering	All stock are to be wintered off farm.
Overflow of contaminants/ Nutrients	Soil nutrients will be managed according to the nutrient management plan. Fertiliser and effluent will only be applied when ground conditions are appropriate utilising visual inspection and the onsite soil moisture monitoring prior to any irrigation.
Cropping	Any cropping or re-grassing undertaken on farm should be undertaken according to industry best practice. Dairy NZ is a useful resource for matters relating to crop paddock selections and management.

ATTACHMENTS

ATTACHMENT A	EFFLUENT DISPOSAL PLAN
ATTACHMENT B	NUTRIENT MANAGEMENT PLAN AND NUTRIENT BUDGET
ATTACHMENT C	MONTHLY CHECK SHEET
ATTACHMENT D	EFFLUENT DISPOSAL RECORD
ATTACHMENT E	STAFF TRAINING GUIDE

ATTACHMENT A EFFLUENT DISPOSAL PLAN

LEGEND

▨ EFFLUENT DISPERSAL AREA (93.00Ha)

— PROPERTY BOUNDARY

Note. Buffers Zones of 20m apply to all Waterways and Boundaries
Buffer Zones of 100m apply to Water Bores and 200m from Residential Dwellings

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EFFLUENT DISPERSAL AREA
RIMU SEAWARD DOWNS ROAD, WAITUNA

Rev.	Date	Revision Details	By
-	-	-	.

Surveyed	Signed	Date	Job No.	Drawing No.
			S14303	01
Drawn	Signed	Date	Scale	
SLC		29.01.15	1:2500 @ A1 1:5000 @ A3	
Designed	Signed	Date	Datum & Level	Rev.
			NZTM 2000 & MSL	-

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TILE DRAIN MAP
RIMU SEAWARD DOWNS ROAD, WAITUNA

Rev.	Date	Revision Details	By
-	-	-	-

Surveyed	Signed	Date	Job No.	Drawing No.
			S14303	01
Drawn	Signed	Date	Scale	
JS		29.06.15	1:2500 @ A1 1:5000 @ A3	
Designed	Signed	Date	Datum & Level	Rev.
			NZTM 2000	-

ATTACHMENT B NUTRIENT MANAGEMENT PLAN & NUTRIENT BUDGETS

Roslin Consultancy Ltd
ALEX HUNTER Agribusiness Consultants MIRANDA HUNTER

Schrader Conversion Proposal

Introduction

The property is located in the Waituna Catchment in Southland.

This property comprises of 109.52 ha in total. The property currently operates as a dairying grazing (young stock and cow wintering) and beef unit.

It is proposed that the property will be converted to dairying, with all young stock grazed off and all of the mature dairy cows will be wintered off.

Nutrient budgets have been constructed to estimate the nutrient loss from the existing operation (2015 / 16 season) and the proposed conversion (status quo).

Overseer Version

6.2.3

Information on Overseer can be obtained from the following reports

Technical Description of OVERSEER for Regional Councils, September 2015

Review of the phosphorus loss submodel in OVERSEER®, September 2016

Protocols

The nutrient budget has been developed using the "Overseer, Best Practice Data Input Standards, November 2016" – no deviations have been made from this protocol

Assumptions

To construct the nutrient budgets the following assumptions have been made;

Blocks

The farm has been split into the following blocks.

Block Name	**Soil Type**	**Smap Ref**	**Contour**	**Existing Operation (ha)**	**Proposed Conversion (ha)**
Pastoral Woodlands	Woodlands	Wood_29a.1	Flat	87.0	61.0
Effluent Woodlands	Woodlands	Wood_29a.1	Flat	0	26.0
Pastoral Dacre	Dacre	Paro_4a.1	Flat	16.0	16.0
Stock excluded				7.0	7.0
	Effective Farm Area			**103.0ha**	**103.0ha**
	Total Farm Area			**110.0ha**	**110.0ha**
Kale (rotating)				20.0ha	2.0 ha

- Soils on the property were assessed utilising the topoclimate information and Overseer soil settings were obtained from SMap
- Predicted soil test values have been used for a status quo dairy farm

Climate Data

- Invercargill as the location setting
- The following climate information has been used from the Overseer climate station tool;
    - 1152mm of rainfall
    - 10.1 degrees Celsius mean annual temperature
    - Daily rainfall pattern setting of 731 to 1450mm, none to weak
    - Mean annual PET of 775mm (moderate variation)

Farm System

Description	**Existing Operation (15 / 16)**	**Proposed Conversion**
Milk solids production		123,600 kg ms • 1200 kg ms per ha • 404 kg ms per cow
Cows on farm		Breed FJX July 0 Aug 320 Sept 315 Oct 306 Nov 306 Dec 306 Jan 306 Feb 300 March 300 April 270 May 240 June 0 **Peak cows milked = 306**
Mature cows and R2 heifers wintered on farm	95 R2s May 265 June and July 90 August	0
Replacements on farm	270 weaners (Dec to April) 270 yearlings (May to Jan) 242 yearlings (Feb to April)	0
Beef animals	29 Bulls 10 Beef breeding cows	0
Area crop	20 ha kale (yield 12 t DM / ha) • Grazed by beef / dairy animals – June, July and August	2 ha kale (yield 12 t DM / ha) • Grazed by cows August & September
Supplements	Imported • 47t DM baleage (fed on kale)	Imported • 225t DM baleage (fed across pastoral blocks)
Nitrogen	159 kg N per ha across all pastoral areas	152 kg N per ha on non effluent blocks, split applications Aug to March 101 kg N per ha on effluent block, split applications Sept to Feb
Farm dairy effluent	n/a	Holding pond Solids not separated Applied to 26 ha (low application)*
Overseer - predicted pasture grown	15.0 t DM / ha / year	15.1 t DM / ha / year

*Effluent area of 26 ha has been assumed in modelling, the area may be larger than this and reduce the nutrient loading accordingly. The N loading from effluent on the 26 ha is 93 kg / ha / yr.

Predicted Overseer Results –

	Existing Operation 15/16	Proposed Conversion
Total Farm N Loss	4338 kg N	2803 kg N
N Loss/ha	40 kg N / ha / year	25 kg N / ha / year
N Concentration in Drainage	Pastoral – 5.2 to 6.3 ppm Fodder crops – 18.8 ppm	Pastoral – 4.0 to 5.7 ppm Fodder crop – 20.9 ppm
Total Farm P Loss	47 kg P	78 kg P
Average P loss/ha	0.4 kg P /ha/yr	0.7 kg P /ha/yr

Miranda Hunter, Roslin Consultancy Limited

Bachelor of Agricultural Science

CNMA

5th December 2016

Roslin Consultancy Ltd
ALEX HUNTER *Agribusiness Consultants* MIRANDA HUNTER

Schrader Specialist Grazier Proposal

Introduction

The property is located in the Waituna Catchment in Southland.

This property comprises of 109.52 ha in total. The property currently operates as a dairying grazing (young stock and cow wintering) and beef unit.

Nutrient budgets have been constructed to estimate the nutrient loss from the existing operation (2015 / 16 season) and a specialist grazing operation (status quo).

Overseer Version

6.2.3

Information on Overseer can be obtained from the following reports

Technical Description of OVERSEER for Regional Councils, September 2015

Review of the phosphorus loss submodel in OVERSEER®, September 2016

Protocols

The nutrient budget has been developed using the "Overseer, Best Practice Data Input Standards, November 2016" – no deviations have been made from this protocol

Assumptions

To construct the nutrient budgets the following assumptions have been made;

Blocks

The farm has been split into the following blocks.

Block Name	**Soil Type**	**Smap Ref**	**Contour**	**Existing Operation (ha)**	**Specialist Grazier (ha)**
Pastoral Woodlands	Woodlands	Wood_29a.1	Flat	87.0	39.0
Effluent Woodlands	Woodlands	Wood_29a.1	Flat	0	0
Pastoral Dacre	Dacre	Paro_4a.1	Flat	16.0	16.0
Fodderbeet	Woodlands	Wood_29a.1	Flat	0	16.0
Kale	Woodlands	Wood_29a.1	Flat	0	16.0
Kale 2nd crop	Woodlands	Wood_29a.1	Flat	0	16.0
Stock excluded				7.0	7.0
	Effective Farm Area			**103.0ha**	**103.0ha**
	Total Farm Area			**110.0ha**	**110.0ha**
Kale (rotating)				20.0ha	

- Soils on the property were assessed utilising the topoclimate information and Overseer soil settings were obtained from SMap

Climate Data

- Invercargill as the location setting
- The following climate information has been used from the Overseer climate station tool;
    - 1152mm of rainfall
    - 10.1 degrees Celsius mean annual temperature
    - Daily rainfall pattern setting of 731 to 1450mm, none to weak
    - Mean annual PET of 775mm (moderate variation)

H.6 Response to Monitoring of Surface Water

The monitoring results from the current land use can be used to provide a benchmark of N and P loads (referred to as the 'benchmark level').

Modelled losses should not exceed 29 kg N/ha/year and 0.6 kg P/ha/year, or equivalent if the Overseer® version changes (referred to as the 'maximum threshold level').

The outputs from the Overseer® modelling (to be done annually to incorporate any changes in the farm operation or soil tests) should also be assessed against the monitoring results to ensure best practices are being applied (referred to as the 'annual level').

If sampling results indicate N or P losses exceed either the benchmark or maximum threshold levels, or if concentrations in tile drain discharge exceeds that measured in the receiving environment, an investigation into the cause must be undertaken by suitably qualified person(s). This may include additional water quality sampling (e.g. upstream and downstream of the property) as appropriate. The results of the investigation must be reported to Environment Southland.

The monitoring results, including an assessment against the annual level, should be incorporated in the annual review of the FEMP.

Note: The levels are difficult to establish without knowing what the maximum flow from the tile drains are. However, set out below is a methodology that could be used to set those limits once the data has been collected.

Tile drain flow (m^3/s) x TN or TP (g/m) concentration= tile drain load ($g/m^2/s$). Multiple this by 3.1536 to get an estimate of kg TN or TP/ha/year.

DON, TAN, NNN, DRP, and TDP can be used to help determine the likely source of TN and TP (e.g. how much is natural inputs) and will inform any investigation (if required).

Farm System

Description	Existing Operation (15 / 16)	Specialist grazier
Mature cows and R2 heifers wintered on farm	95 R2s May 265 June and July 90 August	900 June and July 500 August
Replacements on farm	270 weaners (Dec to April) 270 yearlings (May to Jan) 242 yearlings (Feb to April)	150 weaners (Dec to April) 150 yearlings (May to May)
Beef animals	29 Bulls 10 Beef breeding cows	0
Area crop	20 ha kale (yield 12 t DM / ha) • Grazed by beef / dairy animals – June, July and August	16 ha fodderbeet (yield 20 t DM / ha) • Grazed by cows and yearlings June to August 16 ha kale (yield 12 t DM / ha) • Grazed by cows and yearlings June to August 16 ha kale – 2nd crop (yield 12 t DM / ha) • Grazed by cows and yearlings June to August
Supplements	Imported • 47t DM baleage (fed on kale)	Imported • None
Nitrogen	159 kg N per ha across all pastoral areas	159 kg N per ha across all pastoral areas
Overseer - predicted pasture grown	15.0 t DM / ha / year	14.9 t DM / ha / year

Predicted Overseer Results –

	Existing Operation 15/16	Specialist Grazier
Total Farm N Loss	4338 kg N	5023 kg N
N Loss/ha	40 kg N / ha / year	46 kg N / ha / year
N Concentration in Drainage	Pastoral – 5.2 to 6.3 ppm Fodder crops – 18.8 ppm	Pastoral – 4.4 to 5.7 ppm Fodder crop – 10.7 to 21.1 ppm
Total Farm P Loss	47 kg P	52 kg P
Average P loss/ha	0.4 kg P /ha/yr	0.5 kg P /ha/yr

Miranda Hunter, Roslin Consultancy Limited

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17th November 2016

Fertiliser Use

Introduction

Achieving the best result from fertiliser starts with good storage, transport and handling. Absorption of atmospheric moisture will shorten the acceptable storage period and also impact on handling, flow and spreading characteristics.

Fertiliser storage

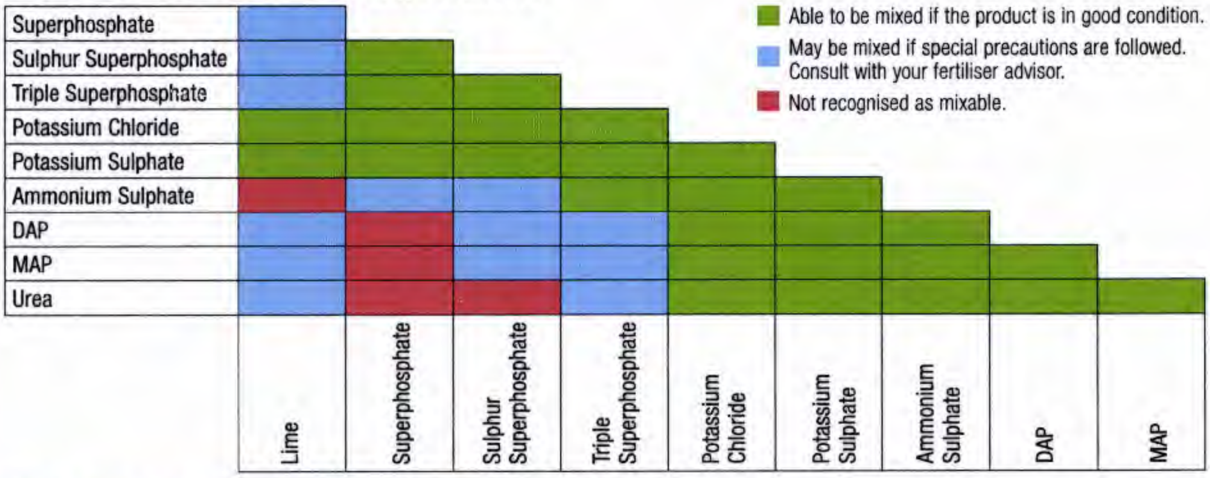
- Keep it dry and free from contamination
- Use an impermeable (moisture proof) concrete floor
- Wrap stored fertiliser e.g. bags (include a layer under the bags)

Compatibility for mixing

- Check chemical and physical compatibility using the guide below
- Mixing fertilisers will generally make them more prone to moisture absorption
- Wherever possible, mix immediately prior to use
- Ensure particle size of blended fertilisers are similar
- More than 10% difference in particle size can lead to separation during transport and handling
- Seek qualified and appropriate advice before blending fertilisers

NB: Do not blend herbicides or other agrichemicals with fertiliser, as it may result in unpredictable responses, reduced effectiveness or even hazardous chemical reactions.

Compatibility Guide for Blending Fertilisers



	Lime	Superphosphate	Sulphur Superphosphate	Triple Superphosphate	Potassium Chloride	Potassium Sulphate	Ammonium Sulphate	DAP	MAP
Superphosphate	🟦								
Sulphur Superphosphate	🟦	🟩							
Triple Superphosphate	🟦	🟩	🟩						
Potassium Chloride	🟩	🟩	🟩	🟩					
Potassium Sulphate	🟩	🟩	🟩	🟩	🟩				
Ammonium Sulphate	🟥	🟦	🟦	🟩	🟩	🟩			
DAP	🟦	🟥	🟦	🟦	🟩	🟩	🟩		
MAP	🟦	🟥	🟦	🟦	🟩	🟩	🟩	🟩	
Urea	🟦	🟥	🟥	🟦	🟩	🟩	🟩	🟩	🟩

🟩 Able to be mixed if the product is in good condition.

🟦 May be mixed if special precautions are followed. Consult with your fertiliser advisor.

🟥 Not recognised as mixable.

Timing of application

Correct timing can be critical for an economic response and value for money.

Nitrogen (N) – If the plant can't take up and respond to applied nitrogen, then the nitrogen is at risk of being lost through leaching or atmospheric losses. Timing for nitrogen application must match appropriate growing conditions and plant health.

The following factors influence recommendations for the amount and timing of nitrogen applications because they affect the potential for optimum plant growth:

- Soil temperature (>6°C at 10cm and 9am)
- Soil moisture (avoid the extremes of either being too wet or too dry)
- Soil compaction
- Plant species/cultivar
- Field history
- Plant disease levels

If more than 50 kg N/ha/yr is required, then split applications are recommended.

Potassium (K) – With a high rainfall (>1500mm year) spring applications are preferred to autumn.

For ash or pumice soils with lower rainfall, then spring and autumn applications are equally effective.

If more than 50 kg K/ha/yr is required, then split applications are recommended.

Avoid application of K immediately before calving/lambing.

Superphosphate and Lime – Timing is considered less critical for these products. However, timing for the sulphur content of superphosphate can be important on sedimentary, peat or pumice soils – particularly under higher rainfall. Using a mixture of sulphate sulphur and elemental sulphur can reduce the requirement of split applications for sulphur. Care should be taken to ensure superphosphate particles are not washed into waterways.

Applications of greater than 100 kg P/ha (1 tonne of superphosphate/ha) should be split.

Reactive Rock Phosphate (RPR) – Phosphorus is only slowly released from RPR and the rate of dissolution is influenced by RPR properties (i.e. particle size, chemical make-up of the RPR used) and farm properties (i.e. soil pH, rainfall, drainage and exchangeable magnesium). It is recommended soil pH is below 6.0 and that there is at least 800mm annual rainfall for RPR to be most effective. RPR will reduce the potential for runoff losses of phosphorus from applied fertiliser during the first 0–50 days after application, however, over the longer term losses from RPR and more soluble fertilisers are similar. Care should be taken to ensure RPR particles are not washed into waterways.

To avoid "acute fluorosis" it is recommended that stock are not grazed on pastures which have received phosphate fertilisers for 21 days or until 25mm rain has fallen.

Product selection

Choice of fertiliser may be influenced by many factors including:

- Cost per tonne/cost per nutrient
- Nutrient analysis (% N, P, K, S, Ca, Mg + trace elements)
- Fertmark assurance
- Anticipated plant response and economic return on investment
- Particle size
- Dissolution rate
- Effects on pH
- Blending and handling characteristics
- Soil nutrient test results
- Physical structure of soil
- Animal health requirements
- Potential for off farm impacts
- Presence of contaminants
- Spreading characteristics
- Flowability from aircraft

Environmental considerations:

- Risk of surface runoff to waterways
- Risk of leaching to sub-surface drains or groundwater
- Risk of high rainfall/no rainfall
- Neighbouring properties (schools, homes, etc)

Your fertiliser sales representative or a Certified Nutrient Management Adviser can help match the correct requirements for farming goals and farming system.

For more information see: A local Certified Nutrient Management Adviser (www.nmacertification.org.nz)
Your Fertiliser Sales Representative
Fertiliser Association of New Zealand (www.fertiliser.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)

Fertiliser Use – Potential Impact on Surface and Ground Water

Introduction

Nutrients come from a wide range of sources, not just from fertiliser.

Excess nutrient can cause health risks with drinking water and eutrophication of fresh waterways and lakes. The World Health Organization recommends drinking water should contain no more than 11.3mg of nitrate nitrogen per litre.

(For livestock; the recommended maximum is 40mg of nitrate nitrogen/litre of water for cattle and 60mg/litre of water for sheep.)

However, to promote algal growth in freshwater streams and lakes, it only takes around 0.015–0.030mg of dissolved reactive phosphate and 0.040–0.1mg ammonium and nitrate nitrogen per litre of water.

Just like crops, algae and other water plants require nutrients. With increased nitrogen and phosphorus in waterways they can respond quickly to favourable growing conditions and choke streams and reduce water quality – sometimes with the potential for serious consequences to livestock and natural fauna and flora.

Safe drinking water and reduction in algal blooms and choking weed growth can be avoided or mitigated with sensible practices in the application of nutrients in farming systems.

Preventing nutrients from reaching surface water

Nitrogen and phosphate nutrients:

- Avoid direct applications to waterways (make allowances for wind or runoff on steep terrain near waterways)
- Avoid surface runoff due to spreading nutrients before heavy irrigation or anticipated high rainfall events
- Carefully match nutrient application to crop requirements
- Prevent soil erosion or soil pugging by livestock (particulate matter washed into streams can be a source of nutrient contamination, especially for phosphorus)
- Avoid discharge of effluent near waterways or onto mole and tile drain areas at times when soils are near saturation or when drains are flowing
- Where possible, drain to wetlands or riparian/filter strips, not to open water
- Keep livestock out of streams and waterways to reduce nutrient and faecal contamination
- Control runoff from stock races, directing it away from open water
- Place fertiliser storage and loading sites more than 50 metres from open water

Preventing nutrients from reaching ground water

Nitrogen and phosphorus nutrients:

- Carefully match nitrogen applications to plant requirements (account for all sources of nitrogen e.g. effluent, mineralised organic matter from a newly ploughed field or nitrogen fixed by legumes)
- Avoid nutrient applications prior to heavy irrigation or anticipated high rainfall events (the more water flowing through the soil profile the greater the leaching potential)
- Carefully schedule irrigation to meet plant requirements (excessive irrigation will leach valuable nutrients)
- Avoid effluent or fertiliser applications to saturated soils
- Increasing stocking rates increases excreta and therefore nitrogen deposited as urine and dung. To manage this:
  - Take account of effluent as a nutrient source
  - Use nutrient budgets to estimate nutrient inputs (from all sources)
- Use cover crops in winter (a newly ploughed field will release nitrogen as organic matter is mineralised – if there is no crop to utilise released nitrogen it is at risk of leaching under winter rainfall)
- For horticultural applications, band fertiliser close to plant roots, carefully matching plant requirements (this reduces nutrient leaching losses between rows, prior to root development into the inter-row space)
- Split applications – little and often will more closely match plant requirements
- For broadcast application, ensure good calibration and even application of nutrients at rates matching plant requirements
- Use Fertmark and Spreadmark accreditation to ensure consistent products and reliable applications
- Use nutrient budgets and nutrient management plans to fine-tune your farming systems, minimise waste and maximise response to nutrients

Usually nitrogen is far more soluble than phosphorus and is the more likely of the two nutrients to contaminate groundwater.

The exception: phosphorus from soluble P fertiliser or dairy effluent is most mobile soon after it is applied, prior to it being taken up by plants or bound to soil particles and organic matter. This is an important consideration – especially in coarse, sandy soils with low organic matter content.

For more information see: A local Certified Nutrient Management Adviser (www.nmacertification.org.nz)
Your Fertiliser Sales Representative
Your regional council Land Management Officer
DairyNZ (www.dairynz.co.nz)
Fertiliser Association of New Zealand (www.fertiliser.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)

Phosphate Fertiliser Considerations

Introduction

Almost all of New Zealand's soils are naturally deficient in phosphorus and it remains an essential ingredient for successful farming.

To achieve optimum profitability and to avoid or minimise any adverse effects, it is important to give careful consideration to product choice and conditions surrounding the application of phosphorus fertiliser.

Production considerations

Different enterprises require a different balance between an immediate boost in available phosphorus and steady long term availability through maintaining optimum soil levels.

Soil reserves can be built up – traditionally this is considered as being like "money in the bank" – except that excessive levels of soil phosphorus are fiscally wasteful, offer no benefits and can contribute to environmental problems.

The current farming enterprise and soil history will determine the balance required between long term slowly available phosphorus and rapidly available soluble phosphorus which is required to meet immediate plant growth demands.

Animal health considerations

Phosphate rock in its natural state contains fluoride. Therefore, fertilisers such as superphosphate and RPR also contain fluoride. If ingested directly by livestock, livestock can suffer from what is known as "phosphate poisoning" which in severe cases can cause death. This is actually fluoride poisoning.

To avoid "acute fluorosis" it is recommended that stock are not grazed on pastures that have received phosphate fertilisers for 21 days or until 25mm rain has fallen.

Environmental considerations

Phosphorus in waterways – even at very low concentrations – is a major contributing cause of eutrophication of streams and the resulting algal blooms.

Following applications of superphosphate, it can be up to 50–100 days before applied phosphorus appears to reach an equilibrium in adsorption to soil particles. In most soils, phosphorus is strongly bound to soil particles and organic matter, particularly in the surface layers.

Eroded soil particles carrying phosphorus and also runoff carrying soluble forms of phosphorus which are released after recent application of fertiliser (or effluent application) can pose an environmental risk leading to eutrophication of waterways.

Fertilisers derived from phosphate rock will contain naturally occurring impurities such as cadmium. Consider if a cadmium minimisation strategy is required for your particular soil cadmium levels and land use.

The choice of fertiliser and circumstances of fertiliser applications can affect production response, animal health and level of environmental risk.

Choosing the correct phosphate product

Advantages of readily soluble forms:

- Immediate availability for plant uptake and rapid growth response (e.g. establishment of vegetable seedlings)
- After 50–100 days even soluble phosphorus becomes 'bound' to soil and organic matter and then is not readily lost through leaching
- Do not require soil pH <6 and 800mm annual rainfall to ensure solubility

Examples of the more common forms of soluble phosphorus fertilisers include; superphosphate, triple superphosphate, sulphur super, MAP, DAP and compound fertiliser formulations.

Advantages of slower release forms:

- Rate of nutrient release is determined by both RPR properties and soil factors
- Reduced risk of phosphorus losses through runoff and/or leaching during the first 0–50 days after application

Examples of common phosphate fertilisers with lower solubility include; Reactive Phosphate Rock and partially acidulated Reactive Phosphate Rock.

Environmental considerations during application

- Target appropriate soil P levels for your soil type and land use.
- Avoid build-up of excessive soil phosphorus levels. It has a negative impact on the environment when high P levels in eroded soil sediment reach waterways.
- Avoid soluble P application near streams or onto saturated soil – where soluble P can be carried in runoff or leachate – especially where tile or mole drains operate.
- Do not allow fertiliser particles to be applied directly to water or to subsequently wash into open waterways.
- Provide riparian strips adjacent to waterways – the correct width will depend on soil type and topography (wider on steep terrain) to reduce the risk of fertiliser and soil particles being carried into waterways.
- Use wetlands to trap sediment and nutrient.

For more information see: A local Certified Nutrient Management Adviser (www.nmacertification.org.nz)
Your Fertiliser Sales Representative
Your regional council Land Management Officer
Fertiliser Association of New Zealand (www.fertiliser.org.nz)
Ballance Agri-Nutrients Ltd (www.ballance.co.nz)
Ravensdown Fertiliser Co-operative (www.ravensdown.co.nz)

Miranda Hunter
Roslin Consultancy

Client reference:
Farm name: Schrader - Conversion Proposal - v6.2.3 - FINAL (Status Quo)

FarmParameters

OVERSEER

Farm details

Type	Farm type	Full range
Assessment	Assessment year	Status Quo
Region	Region	Invercargill

Farm blocks

Pastoral - Woodlands	Pastoral	61
Pastoral - Dacre	Pastoral	16
Effluent - Woodlands	Pastoral	26
Kale	Fodder Crop	
Non productive	Trees and Scrub	7
Total farm area declared in blocks	ha	110
Total farm area	ha	110
Non-productive area	ha	0

Farm animals

Stock numbers

Stock reconciliation - Dairy

Production

Milk solids	kg/yr	123600
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

Median calving date	24 August
Drying off	20 May
Percent of herd	0

Stock numbers

Class	*Breed*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*
MilkingHerd	F x J cross	0	230	315	306	306	306	306	300	300	270	240	0

Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated
0	0	0	0	0			Female	

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 types on pastoral blocks is the same as the farm stock ratios

Farm dairy effluent management system

Effluent management method		Holding pond
Solid separation and disposal		False
Pond solids		
Pond solids management method		Spread on selected blocks
Pond emptied every	years	2
Liquid effluent		
Liquid management method		Spray regularly

Animal health supplements

Animal - Dairy

No animal supplementation has been entered

Animal - Dairy replacements

No animal supplementation has been entered

Left over feeding

No left over feeding specified

Stored supplements

No supplements from storage added to this farm

FarmParameters

Imported supplements

Supplement information		
Conservation type		Silage
Name		Baleage
Supplement amount		
Dry weight basis	T	225
Supplements are distributed evenly across all pastoral blocks		
No timing of feeding has been specified		

Report settings

Greenhouse gas emission report units: Use default
Target N application rate as effluent: kg N/ha/yr

Block Information

Block - Pastoral - Woodlands

Block name		Pastoral - Woodlands
Block type		Pastoral
Area	ha	61
Relative productivity		1
Pasture block type		Yes
Topography		Flat
Distance from coast	km	18
Cultivated in last 5 years		False
Fodder rotates through		Yes
Climate		
Annual average rainfall	mm/yr	1152
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm, None to weak
Annual potential evapotranspiration	mm	775
Seasonal variation in PET		Moderate
Soil description		
Soil order (default)		Brown
Soil group (default)		Sedimentary
SMaps		
Sibling		Wood_291.1
Date downloaded		Unknown
Wilting point	0 - 30cm	21
	30 - 60cm	24
	> 60	24
Field capacity	0 - 30cm	41
	30 - 60cm	39
	> 60	41
Saturation	0 - 30cm	57
	30 - 60cm	50
	> 60	47
Natural drainage class		Imperfect
Depth to impeded layer	cm	Not entered
Maximum rooting depth	cm	Not entered
Top soil horizon chemical and physical parameters		
ASC/PR	%	43
Bulk density	kg/m³	1090
Clay	%	28
Sand	%	13
Sub soil		
Sub soil clay	%	29
Soil profile		
Profile drainage class		Imperfect
Top soil texture		Unknown
Maximum rooting depth	m	0

FarmParameters

Depth to impeded drainage layer		0

Soil drainage

Drainage method		
Method		Mole/tile system
Percent of paddock drained		40
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False

Soil settings

K leaching (%s)		Medium
N immobilisation status		

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30	7	8	10	8

QT SO4		10
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default

Pasture

Pasture type		Ryegrass/white clover
Clover levels		Use default

Supplements removed

No supplements removed from this block

Fertiliser application

Fertiliser products - December		
Category		Ballance super
Product		Superten
Amount	kg/ha	225
Fertiliser products - September		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - October		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - March		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - January		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - August		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - February		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55

Irrigation

No irrigation entered

Animals on block

Ratio and type of stock based on whole farm values due to this option being selected on block set up

Animals grazing		
Dairy	%	0

FarmParameters

Water connectivity		
Direct access to streams		False
Animal grazing		
January		True
February		True
March		True
April		True
May		True
August		True
September		True
October		True
November		True
December		True
Effluent application		
Solid effluents		
Effluent type added	December	Pond solids/sludge
Block - Pastoral - Dacre		
Block name		Pastoral - Dacre
Block type		Pastoral
Area	ha	16
Relative productivity		1
Pasture block type		Yes
Topography		Flat
Distance from coast	km	18
Cultivated in last 5 years		False
Fodder rotates through		Yes
Climate		
Annual average rainfall	mm/yr	1152
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm, None to weak
Annual potential evapotranspiration	mm	775
Seasonal variation in PET		Moderate
Soil description		
Soil order (default)		Gley
Soil group (default)		Sedimentary
SMaps		
Sibling		Paro_4a.1
Date downloaded		Unknown
Wilting point	0 - 30cm	14
	30 - 60cm	16
	> 60	17
Field capacity	0 - 30cm	47
	30 - 60cm	43
	> 60	46
Saturation	0 - 30cm	63
	30 - 60cm	52
	> 60	53
Natural drainage class		Poor
Depth to impeded layer	cm	Not entered
Maximum rooting depth	cm	Not entered
Top soil horizon chemical and physical parameters		
ASC/PR	%	35
Bulk density	kg/m^3	940
Clay	%	25
Sand	%	9
Sub soil		
Sub soil clay	%	26
Soil profile		
Profile drainage class		Poor
Top soil texture		Unknown

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Roslin Consultancy

FarmParameters

Maximum rooting depth	m	0
Depth to impeded drainage layer		0

Soil drainage

Drainage method	
Method	Mole/tile system
Percent of paddock drained	60
Hydrophobic condition	Use default
Occurence of pugging damage	Occasional
Compacted top soil	False

Soil settings

K leaching (%s)	Medium
N immobilisation status	

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30	7	8	10	8

QT SO4	10
Anion storage capacity or phosphate retention	Not entered
TBK reserve K test	Not entered
K reserve status	Use default

Pasture

Pasture type	Ryegrass/white clover
Clover levels	Use default

Supplements removed

No supplements removed from this block

Fertiliser application

Fertiliser products - December		
Category		Ballance super
Product		Superten
Amount	kg/ha	225
Fertiliser products - September		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - October		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - March		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - January		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - February		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - August		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55

Irrigation

No irrigation entered

Animals on block

Ratio and type of stock based on whole farm values due to this option being selected on block set up

Animals grazing

FarmParameters

Dairy	%	0
Water connectivity		
Direct access to streams		False
Animal grazing		
January		True
February		True
March		True
April		True
May		True
August		True
September		True
October		True
November		True
December		True

Effluent application

Receives no liquid or solid effluents

Block - Effluent - Woodlands

Block name		Effluent - Woodlands
Block type		Pastoral
Area	ha	26
Relative productivity		1
Pasture block type		Yes
Topography		Flat
Distance from coast	km	18
Cultivated in last 5 years		False
Fodder rotates through		Yes

Climate

Annual average rainfall	mm/yr	1152
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm, None to weak
Annual potential evapotranspiration	mm	775
Seasonal variation in PET		Moderate

Soil description

Soil order (default)		Brown
Soil group (default)		Sedimentary
SMaps		
Sibling		Wood_29a.1
Date downloaded		Unknown
Wilting point	0 - 30cm	21
	30 - 60cm	24
	> 60	24
Field capacity	0 - 30cm	41
	30 - 60cm	39
	> 60	41
Saturation	0 - 30cm	57
	30 - 60cm	50
	> 60	47
Natural drainage class		Imperfect
Depth to impeded layer	cm	Not entered
Maximum rooting depth	cm	Not entered
Top soil horizon chemical and physical parameters		
ASC/PR	%	43
Bulk density	kg/m³	1090
Clay	%	28
Sand	%	13
Sub soil		
Sub soil clay	%	29

Soil profile

Profile drainage class		Imperfect
Top soil texture		Unknown

FarmParameters

Maximum rooting depth	m	0
Depth to impeded drainage layer		0
Soil drainage		
Drainage method		
Method		Mole/tile system
Percent of paddock drained		40
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching (%s)		Medium
N immobilisation status		

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30	7	8	10	8

QT SO4		10
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		Use default
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - February		
Category		Ballance super
Product		Superten
Amount	kg/ha	175
Fertiliser products - September		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - October		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - January		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - February		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Irrigation		
No irrigation entered		
Animals on block		
Ratio and type of stock based on whole farm values due to this option being selected on block set up		
Animals grazing		
Dairy	%	0
Water connectivity		
Direct access to streams		False
Animal grazing		
January		True
February		True
March		True
April		True

FarmParameters

May		True
August		True
September		True
October		True
November		True
December		True

Effluent application		
Liquid effluents		
Receives farm dairy effluent		
Effluent application depth		Low application method
Percentage of block effluent applied to	%	100

Block - Kale

Block name		Kale
Block type		Fodder Crop
Rotation area	ha	2
Low N mineralisation		False
Final grid month		November
Irrigation system type		No Irrigation

Crop information

Current assessment year Status Quo		
December - Kale		
Crop management	See details below	Crop sown
Fertiliser or lime added	See details below	
January - Kale		
February - Kale		
Fertiliser or lime added	See details below	
March - Kale		
April - Kale		
May - Kale		
June - Kale		
July - Kale		
August - Kale		
Crop management	See details below	Defoliation
September - Kale		
Crop management	See details below	Defoliation
October - Bare ground		
November - Grazed		
Crop management	See details below	Crop sown

Crop sowing information - December of the Current assessment year Status Quo

Crop category		Fodder
Crop type		Kale
Product yield	T/ha dry matter	12
Cultivation practice at sowing		Conventional

Defoliation information - August of the Current assessment year Status Quo

Defoliation method		Grazed in-situ
Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Dairy	%	100
Crop grazed for	hours/day	16

Defoliation information - September of the Current assessment year Status Quo

Defoliation method		Grazed in-situ
Final harvest		True
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Dairy	%	100
Crop grazed for	hours/day	16

Crop sowing information - November of the Current assessment year Status Quo

FarmParameters

Crop category		Permanent pasture
Crop type		Grazed
Source of animals		Not entered

Fertiliser application

Fertiliser products - Current assessment - December (N Method: Incorporated)

Category		Ballance cropping
Product		Cropzeal brassica base
Amount	kg/ha	250

Fertiliser products - Current assessment - December (N Method: Incorporated)

Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100

Fertiliser products - Current assessment - February (N Method: Surface applied)

Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100

Effluent application

Receives no liquid or solid effluents

Block - Non productive

Block name		Non productive
Block type		Trees and Scrub
Area	ha	7
Rainfall	mm/yr	1152
Distance from coast	km	18
Bush type		Native

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Version 6.2.3, on 2016-12-05 03:23:08

Miranda Hunter
Roslin Consultancy

Client reference:

Farm name: Schrader - Conversion Proposal - v6.2.3 - FINAL (Status Quo)

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added							
Fertiliser, lime & other	130	18	0	21	43	0	0
Rain/clover N fixation	114	0	3	6	4	8	44
Irrigation	0	0	0	0	0	0	0
Supplements imported	33	6	41	5	10	3	3
Nutrients removed							
As products	76	13	18	4	16	2	5
Exported effluent	0	0	0	0	0	0	0
As supplements	0	0	0	0	0	0	0
To atmospheric	95	0	0	0	0	0	0
To water	25	0.7	11	36	42	12	30
Change in internal pools							
Plant material	0	0	-2	1	0	0	0
Organic pool	76	11	-1	-10	-2	0	0
Inorganic mineral	0	4	-22	0	-2	-3	-3
Inorganic soil pool	3	-4	39	0	2	2	14

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Version 6.2.3, on 2016-12-05 03:23:47

Miranda Hunter
Roslin Consultancy

Client reference:

Farm name: Schrader - Conversion Proposal - v6.2.3 - FINAL (Status Quo)

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Pastoral - Woodlands ##	1445	24	5.5	183	158
Pastoral - Dacre ##	266	17	4.0	181	152
Kale	230	115	**20.9**	48	106
Non productive	21	3	N/A		
Effluent - Woodlands ##	648	25	5.7	223	194
Other farm sources	193				
Whole farm	2803	25			
Less N removed in wetlands	0				
Farm output	2803	25			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Has a fodder crop rotating though, results for pastoral block component only

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Miranda Hunter
Roslin Consultancy

Client reference:

Farm name: Schrader - Conversion Proposal - v6.2.3 - FINAL (Status Quo)

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Pastoral - Woodlands ##	17	0.3	Low	Low	Low
Pastoral - Dacre ##	8	0.5	Low	Low	n/a
Kale	1	0.4	n/a	n/a	n/a
Non productive	1	0.1	n/a	n/a	n/a
Effluent - Woodlands ##	8	0.3	Low	Low	Low
Other farm sources	44				
Whole farm	78	0.7			

Has a fodder crop rotating though, results for pastoral block component only

FarmParameters

Farm details

Type	Farm type	Full range
Assessment	Assessment year	Not entered
Region	Region	Invercargill

Farm blocks

Pastoral - Woodlands	Pastoral	39
Pastoral - Dacre	Pastoral	16
Non productive	Trees and Scrub	7
Fodderbeet	Crop	16
Kale	Crop	16
Kale - 2nd crop	Crop	16
Total farm area declared in blocks	ha	110
Total farm area	ha	110
Non-productive area	ha	0

arm animals

Stock numbers

Stock reconciliation - Beef / dairy grazing

Stock production

Calving percentage	%	94
Percent replacements	%	23
Mean calving date		10 September
Mean weaning date		31 December
Weaning weight	kg	120

Stock numbers

Class	*Breed*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*
DairyReplacements	Friesian X jersey	0	0	0	0	0	150	150	150	150	150	150	150
DairyReplacements	Friesian X jersey	150	150	150	150	150	150	150	150	150	150	150	0
DairyMilking	Friesian X jersey	900	500	0	0	0	0	0	0	0	0	0	900

Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated
0	0	0	0	4	Brought	Remain on-farm	Female	
0	0	0	0	11	On-farm	Sold to store/removed	Female	
0	0	0	0	0			Female	

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 types on pastoral blocks is the same as the farm stock ratios

Animal health supplements

Animal - Beef / dairy grazing

No animal supplementation has been entered

Left over feeding

No left over feeding specified

Stored supplements

No supplements from storage added to this farm

Imported supplements

No supplements imported onto this farm

Report settings

FarmParameters

Greenhouse gas emission report units: Use default
Target N application rate as effluent: kg N/ha/yr

Block Information

Block - Pastoral - Woodlands

Block name		Pastoral - Woodlands
Block type		Pastoral
Area	ha	39
Relative productivity		1
Pasture block type		No
Topography		Flat
Distance from coast	km	18
Cultivated in last 5 years		False
Fodder rotates through		No
Climate		
Annual average rainfall	mm/yr	1152
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm, None to weak
Annual potential evapotranspiration	mm	775
Seasonal variation in PET		Moderate
Soil description		
Soil order (default)		Brown
Soil group (default)		Sedimentary
SMaps		
Sibling		Wood_29a.1
Date downloaded		2016 July 14 15:47
Wilting point	0 - 30cm	21
	30 - 60cm	24
	> 60	24
Field capacity	0 - 30cm	41
	30 - 60cm	39
	> 60	41
Saturation	0 - 30cm	57
	30 - 60cm	50
	> 60	47
Natural drainage class		Imperfect
Depth to impeded layer	cm	Not entered
Maximum rooting depth	cm	Not entered
Top soil horizon chemical and physical parameters		
ASC/PR	%	43
Bulk density	kg/m^3	1090
Clay	%	27
Sand	%	12
Sub soil		
Sub soil clay	%	29
Soil profile		
Profile drainage class		Imperfect
Top soil texture		Unknown
Maximum rooting depth	m	0
Depth to impeded drainage layer		0
Soil drainage		
Drainage method		
Method		Mole/tile system
Percent of paddock drained		40
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching (%s)		Medium

FarmParameters

N immobilisation status					Standard
Soil tests					
Olsen P	QT K	QT Ca	QT Mg	QT Na	
30	7	8	10	8	
QT SO4					10
Anion storage capacity or phosphate retention					Not entered
TBK reserve K test					Not entered
K reserve status					Use default

Pasture

Pasture type	Ryegrass/white clover
Clover levels	Use default

Supplements removed

Supplement information

Conservation type		Baleage
Name		
Wrapping		Wrapped in plastic
Supplement amount		
Dry weight basis	T	304

Fed on blocks: Pastoral - Woodlands,Pastoral - Dacre,Fodderbeet,Kale,Kale - 2nd crop
No timing of feeding has been specified

Fertiliser application

Fertiliser products - February		
Category		Ballance super
Product		Superten
Amount	kg/ha	500
Fertiliser products - August		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	60
Fertiliser products - September		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	60
Fertiliser products - October		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	40
Fertiliser products - March		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	80
Fertiliser products - April		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	65
Fertiliser products - May		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	40

Irrigation

No irrigation entered

Animals on block

Ratio and type of stock based on whole farm values due to this option being selected on block set up

Animals grazing		
Beef / dairy grazing	%	0
Block intensity		
Finishing beef		False
Water connectivity		
Direct access to streams		False

FarmParameters

Animal grazing
Beef / dairy grazing graze block all year round

Effluent application
Receives no liquid or solid effluents

Block - Pastoral - Dacre

Block name		Pastoral - Dacre
Block type		Pastoral
Area	ha	16
Relative productivity		1
Pasture block type		No
Topography		Flat
Distance from coast	km	18
Cultivated in last 5 years		False
Fodder rotates through		No

Climate

Annual average rainfall	mm/yr	1152
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm, None to weak
Annual potential evapotranspiration	mm	775
Seasonal variation in PET		Moderate

Soil description

Soil order (default)		Gley
Soil group (default)		Sedimentary
SMaps		
Sibling		Paro_4a.1
Date downloaded		2016 July 14 15:48
Wilting point	0 - 30cm	14
	30 - 60cm	16
	> 60	17
Field capacity	0 - 30cm	47
	30 - 60cm	43
	> 60	46
Saturation	0 - 30cm	63
	30 - 60cm	52
	> 60	53
Natural drainage class		Poor
Depth to impeded layer	cm	Not entered
Maximum rooting depth	cm	Not entered
Top soil horizon chemical and physical parameters		
ASC/PR	%	35
Bulk density	kg/m³	940
Clay	%	25
Sand	%	9
Sub soil		
Sub soil clay	%	26

Soil profile

Profile drainage class		Poor
Top soil texture		Unknown
Maximum rooting depth	m	0
Depth to impeded drainage layer		0

Soil drainage

Drainage method		
Method		Mole/tile system
Percent of paddock drained		60
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False

Soil settings

FarmParameters

K leaching (%s)	Medium
N immobilisation status	Standard

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30	7	8	10	8

QT SO4	10
Anion storage capacity or phosphate retention	Not entered
TBK reserve K test	Not entered
K reserve status	Use default

Pasture

Pasture type	Ryegrass/white clover
Clover levels	Use default

Supplements removed

No supplements removed from this block

Fertiliser application

Fertiliser products - February		
Category		Ballance super
Product		Superten
Amount	kg/ha	500
Fertiliser products - August		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	60
Fertiliser products - September		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	60
Fertiliser products - October		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	40
Fertiliser products - March		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	80
Fertiliser products - April		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	65
Fertiliser products - May		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	40

Irrigation

No irrigation entered

Animals on block

Ratio and type of stock based on whole farm values due to this option being selected on block set up

Animals grazing		
Beef / dairy grazing	%	0
Block intensity		
Finishing beef		False
Water connectivity		
Direct access to streams		False
Animal grazing		
Beef / dairy grazing graze block all year round		

Effluent application

Receives no liquid or solid effluents

Block - Non productive

FarmParameters

Block name		Non productive
Block type		Trees and Scrub
Area	ha	7
Rainfall	mm/yr	1152
Distance from coast	km	18
Bush type		Native

Block - Fodderbeet

Block name		Fodderbeet
Block type		Crop
Area	ha	16
Cultivated area	% of area	100
Headland area	% of area	0
Other area	% of area	0
Distance from coast	km	18
Final grid month		October
Irrigation system type		No Irrigation

Climate

Annual average rainfall	mm/yr	1152
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm, Low
Annual potential evapotranspiration	mm	775
Seasonal variation in PET		Moderate

Soil description

Soil order (default)		Brown
Soil group (default)		Sedimentary
SMaps		
Sibling		Wood_29a.1
Date downloaded		2016 July 15 10:23
Wilting point	0 - 30cm	21
	30 - 60cm	24
	> 60	24
Field capacity	0 - 30cm	41
	30 - 60cm	39
	> 60	41
Saturation	0 - 30cm	57
	30 - 60cm	50
	> 60	47
Natural drainage class		Imperfect
Depth to impeded layer	cm	Not entered
Maximum rooting depth	cm	Not entered
Top soil horizon chemical and physical parameters		
ASC/PR	%	43
Bulk density	kg/m³	1090
Clay	%	27
Sand	%	12
Sub soil		
Sub soil clay	%	29

Soil profile

Profile drainage class		Use default
Top soil texture		Unknown
Maximum rooting depth	m	0
Depth to impeded drainage layer		0

Soil drainage

Drainage method		
Method		Mole/tile system
Percent of paddock drained		40

Soil settings

K leaching potential not set

FarmParameters

Soil tests

Organic S	10
Anion storage capacity or phosphate retention	Not entered
TBK reserve K test	Not entered
K reserve status	Use default

Crop block history

Years in pasture	5
Prior history	Grazed pasture

Source of animal information

Animal source	Farm stock - see Enterprise numbers panes
Pasture consumption by each class same as farm ratio	

Crop information

Previous assesment year

November - Grazed pasture
December - Grazed pasture
January - Grazed pasture
February - Grazed pasture
March - Grazed pasture
April - Grazed pasture
May - Grazed pasture
June - Grazed pasture
July - Grazed pasture
August - Grazed pasture
September - Grazed pasture
October - Grazed pasture

Current assessment year

November - Fodder beets		
Crop management	See details below	Crop sown
Fertiliser or lime added	See details below	
December - Fodder beets		
January - Fodder beets		
Fertiliser or lime added	See details below	
February - Fodder beets		
March - Fodder beets		
April - Fodder beets		
May - Mature - Fodder beets		
June - Fodder beets		
Crop management	See details below	Defoliation
July - Fodder beets		
Crop management	See details below	Defoliation
August - Fodder beets		
Crop management	See details below	Defoliation
September - Bare ground		
October - Bare ground		

Crop sowing information - November of the Current assessment year

Crop category		Fodder
Crop type		Fodder beets
Product yield	T/ha dry matter	20
Cultivation practice at sowing		Conventional

Defoliation information - June of the Current assessment year

Defoliation method		Grazed in-situ
Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered

Defoliation information - July of the Current assessment year

FarmParameters

Defoliation method		Grazed in-situ
Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered

Defoliation information - August of the Current assessment year

Defoliation method		Grazed in-situ
Final harvest		True
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered

Fertiliser application

Fertiliser products - Current assessment - November (N Method: Incorporated)

Category		Ballance other
Product		DAP
Amount	kg/ha	250

Fertiliser products - Current assessment - November (N Method: None)

Category		Ballance other
Product		Muriate of potash
Amount	kg/ha	100

Fertiliser products - Current assessment - January (N Method: Surface applied)

Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100

Effluent application

Receives no liquid or solid effluents

Block - Kale

Block name		Kale
Block type		Crop
Area	ha	16
Cultivated area	% of area	100
Headland area	% of area	0
Other area	% of area	0
Distance from coast	km	18
Final grid month		October
Irrigation system type		No Irrigation

Climate

Annual average rainfall	mm/yr	1152
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm, Low
Annual potential evapotranspiration	mm	775
Seasonal variation in PET		Moderate

Soil description

Soil order (default)		Brown
Soil group (default)		Sedimentary
SMaps		
Sibling		Wood_29a.1
Date downloaded		2016 July 15 10:23
Wilting point	0 - 30cm	21
	30 - 60cm	24
	> 60	24
Field capacity	0 - 30cm	41
	30 - 60cm	39
	> 60	41
Saturation	0 - 30cm	57
	30 - 60cm	50
	> 60	47

FarmParameters

Natural drainage class		Imperfect
Depth to impeded layer	cm	Not entered
Maximum rooting depth	cm	Not entered
Top soil horizon chemical and physical parameters		
ASC/PR	%	43
Bulk density	kg/m³	1090
Clay	%	27
Sand	%	12
Sub soil		
Sub soil clay	%	29
Soil profile		
Profile drainage class		Use default
Top soil texture		Unknown
Maximum rooting depth	m	0
Depth to impeded drainage layer		0
Soil drainage		
Drainage method		
Method		Mole/tile system
Percent of paddock drained		40
Soil settings		
K leaching potential not set		
Soil tests		
Organic S		10
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Crop block history		
Years in pasture		5
Prior history		Crop
Crop information		
Previous assesment year		
November - Fodder beets		
Crop management	See details below	Crop sown
Fertiliser or lime added	See details below	
December - Fodder beets		
January - Fodder beets		
Fertiliser or lime added	See details below	
February - Fodder beets		
March - Fodder beets		
April - Fodder beets		
May - Mature - Fodder beets		
June - Fodder beets		
Crop management	See details below	Defoliation
July - Fodder beets		
Crop management	See details below	Defoliation
August - Fodder beets		
Crop management	See details below	Defoliation
September - Bare ground		
October - Bare ground		
Current assessment year		
November - Bare ground		
December - Kale		
Crop management	See details below	Crop sown
Fertiliser or lime added	See details below	
January - Kale		
February - Kale		
Fertiliser or lime added	See details below	
March - Kale		

FarmParameters

Fertiliser or lime added	See details below	
April - Kale		
May - Kale		
June - Kale		
Crop management	See details below	Defoliation
July - Kale		
Crop management	See details below	Defoliation
August - Kale		
Crop management	See details below	Defoliation
September - Bare ground		
October - Bare ground		

Crop sowing information - November of the Previous assessment

Crop category		Fodder
Crop type		Fodder beets
Product yield	T/ha dry matter	20
Cultivation practice at sowing		Conventional

Defoliation information - June of the Previous assessment

Defoliation method		Grazed in-situ
Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered

Defoliation information - July of the Previous assessment

Defoliation method		Grazed in-situ
Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered

Defoliation information - August of the Previous assessment

Defoliation method		Grazed in-situ
Final harvest		True
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered

Crop sowing information - December of the Current assessment year

Crop category		Fodder
Crop type		Kale
Product yield	T/ha dry matter	12
Cultivation practice at sowing		Conventional

Defoliation information - June of the Current assessment year

Defoliation method		Grazed in-situ
Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered

Defoliation information - July of the Current assessment year

Defoliation method		Grazed in-situ
Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered

Defoliation information - August of the Current assessment year

Defoliation method		Grazed in-situ

FarmParameters

Final harvest		True
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered

Fertiliser application

Fertiliser products - Previous assessment - November (N Method: Incorporated)		
Category		Ballance other
Product		DAP
Amount	kg/ha	250
Fertiliser products - Previous assessment - November (N Method: Incorporated)		
Category		Ballance other
Product		Muriate of potash
Amount	kg/ha	100
Fertiliser products - Previous assessment - January (N Method: Surface applied)		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100
Fertiliser products - Current assessment - December (N Method: Incorporated)		
Category		Ballance cropping
Product		Cropzeal boron boost
Amount	kg/ha	250
Fertiliser products - Current assessment - February (N Method: Surface applied)		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100
Fertiliser products - Current assessment - March (N Method: Surface applied)		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100

Effluent application

Receives no liquid or solid effluents

Block - Kale - 2nd crop

Block name		Kale - 2nd crop
Block type		Crop
Area	ha	16
Cultivated area	% of area	100
Headland area	% of area	0
Other area	% of area	0
Distance from coast	km	18
Final grid month		October
Irrigation system type		No Irrigation

Climate

Annual average rainfall	mm/yr	1152
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm, Low
Annual potential evapotranspiration	mm	775
Seasonal variation in PET		Moderate

Soil description

Soil order (default)		Brown
Soil group (default)		Sedimentary
SMaps		
Sibling		Wood_29a.1
Date downloaded		2016 July 15 10:23
Wilting point	0 - 30cm	21
	30 - 60cm	24
	> 60	24
Field capacity	0 - 30cm	41
	30 - 60cm	39
	> 60	41

FarmParameters

Saturation	0 - 30cm	57
	30 - 60cm	50
	> 60	47
Natural drainage class		Imperfect
Depth to impeded layer	cm	Not entered
Maximum rooting depth	cm	Not entered
Top soil horizon chemical and physical parameters		
ASC/PR	%	43
Bulk density	kg/m^3	1090
Clay	%	27
Sand	%	12
Sub soil		
Sub soil clay	%	29
Soil profile		
Profile drainage class		Use default
Top soil texture		Unknown
Maximum rooting depth	m	0
Depth to impeded drainage layer		0
Soil drainage		
Drainage method		
Method		Mole/tile system
Percent of paddock drained		40
Soil settings		
K leaching potential not set		
Soil tests		
Organic S		10
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Crop block history		
Years in pasture		5
Prior history		Crop
Crop information		
Previous assesment year		
November - Crop		
December - Kale		
Crop management	See details below	Crop sown
Fertiliser or lime added	See details below	
January - Kale		
February - Kale		
Fertiliser or lime added	See details below	
March - Kale		
Fertiliser or lime added	See details below	
April - Kale		
May - Kale		
June - Kale		
Crop management	See details below	Defoliation
July - Kale		
Crop management	See details below	Defoliation
August - Kale		
Crop management	See details below	Defoliation
September - Bare ground		
October - Bare ground		
Current assessment year		
November - Bare ground		
December - Kale		
Crop management	See details below	Crop sown
Fertiliser or lime added	See details below	

FarmParameters

January - Kale		
February - Kale		
Fertiliser or lime added	See details below	
March - Kale		
Fertiliser or lime added	See details below	
April - Kale		
May - Kale		
June - Kale		
Crop management	See details below	Defoliation
July - Kale		
Crop management	See details below	Defoliation
August - Kale		
Crop management	See details below	Defoliation
September - Bare ground		
October - Bare ground		

Crop sowing information - December of the Previous assessment		
Crop category		Fodder
Crop type		Kale
Product yield	T/ha dry matter	12
Cultivation practice at sowing		Conventional
Defoliation information - June of the Previous assessment		
Defoliation method		Grazed in-situ
Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered
Defoliation information - July of the Previous assessment		
Defoliation method		Grazed in-situ
Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered
Defoliation information - August of the Previous assessment		
Defoliation method		Grazed in-situ
Final harvest		True
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered
Crop sowing information - December of the Current assessment year		
Crop category		Fodder
Crop type		Kale
Product yield	T/ha dry matter	12
Cultivation practice at sowing		Conventional
Defoliation information - June of the Current assessment year		
Defoliation method		Grazed in-situ
Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered
Defoliation information - July of the Current assessment year		
Defoliation method		Grazed in-situ
Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		

FarmParameters

Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered
Defoliation information - August of the Current assessment year		
Defoliation method		Grazed in-situ
Final harvest		True
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered
Fertiliser application		
Fertiliser products - Previous assessment - December (N Method: Incorporated)		
Category		Ballance cropping
Product		Cropzeal boron boost
Amount	kg/ha	250
Fertiliser products - Previous assessment - February (N Method: Surface applied)		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100
Fertiliser products - Previous assessment - March (N Method: Surface applied)		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100
Fertiliser products - Current assessment - December (N Method: Incorporated)		
Category		Ballance cropping
Product		Cropzeal boron boost
Amount	kg/ha	250
Fertiliser products - Current assessment - February (N Method: Surface applied)		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100
Fertiliser products - Current assessment - March (N Method: Surface applied)		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100

Effluent application

Receives no liquid or solid effluents

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H & S Schrader

Miranda Hunter
Roslin Consultancy Limited

Client reference:

Farm name: Schrader - Specialist Grazing - v 6.2.3

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added							
Fertiliser, lime & other	131	44	7	27	55	0	0
Rain/clover N fixation	55	0	3	6	4	8	44
Irrigation	0	0	0	0	0	0	0
Supplements imported	0	0	0	0	0	0	0
Nutrients removed							
As products	144	35	10	17	72	2	4
Exported effluent	0	0	0	0	0	0	0
As supplements	0	0	0	0	0	0	0
To atmospheric	48	0	0	0	0	0	0
To water	46	0.5	6	29	59	11	30
Change in internal pools							
Plant material	-15	-1	-24	6	0	-1	-1
Organic pool	-55	2	6	-19	1	0	0
Inorganic mineral	0	4	-25	0	-2	-3	-3
Inorganic soil pool	19	4	38	0	-72	0	13

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H & S Schrader

Miranda Hunter
Roslin Consultancy Limited

Client reference:
Farm name: Schrader - Specialist Grazing - v 6.2.3

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Pastoral - Woodlands	748	19	4.4	84	159
Pastoral - Dacre	387	24	5.7	124	159
Non productive	21	3	N/A		
Fodderbeet	1759	110	**21.1**	-163	90
Kale	997	62	10.7	33	133
Kale - 2nd crop	1082	68	**11.6**	33	133
Other farm sources	29				
Whole farm	5023	46			
Less N removed in wetlands	0				
Farm output	5023	46			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

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H & S Schrader

Miranda Hunter
Roslin Consultancy Limited

Client reference:

Farm name: Schrader - Specialist Grazing - v 6.2.3

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Pastoral - Woodlands	12	0.3	Low	Low	n/a
Pastoral - Dacre	8	0.5	Low	Low	n/a
Non productive	1	0.1	n/a	n/a	n/a
Fodderbeet	6	0.4	n/a	n/a	n/a
Kale	6	0.4	n/a	n/a	n/a
Kale - 2nd crop	6	0.4	n/a	n/a	n/a
Other farm sources	13				
Whole farm	52	0.5			

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H & S Schrader

Client reference:
Farm name: Schrader - Current Farm - v 6.2.3 (15/16)

Miranda Hunter
Roslin Consultancy Limited

FarmParameters

Farm details

Type	Farm type	Full range
Assessment	Assessment year	15/16
Region	Region	Invercargill

Farm blocks

Pastoral - Woodlands	Pastoral	87
Pastoral - Dacre	Pastoral	16
Kale	Fodder Crop	
Non productive	Trees and Scrub	7
Total farm area declared in blocks	ha	110
Total farm area	ha	110
Non-productive area	ha	0

Farm animals

Stock numbers

Stock reconciliation - Beef / dairy grazing

Stock production

Calving percentage	%	94
Percent replacements	%	23
Mean calving date		10 September
Mean weaning date		31 December
Weaning weight	kg	120

Stock numbers

Class	*Breed*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*
DairyReplacements	Friesian X jersey	0	0	0	0	0	270	270	270	270	270	270	270
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	4	Brought	Remain on-farm	Female						
DairyReplacements	Friesian X jersey	270	270	270	270	270	270	270	242	242	242	0	0
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	11	On-farm	Sold to store/removed	Female						
DairyMilking	Friesian X jersey	265	90	0	0	0	0	0	0	0	0	95	265
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	0			Female						
Bulls	Friesian X jersey	29	29	29	29	29	29	29	29	29	29	29	29
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	11	Brought	Sold to store/removed	Male						
CowsBreeding	Beef Type	10	10	10	10	10	10	10	10	10	10	10	10
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	23			Female	No mating					

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 types on pastoral blocks is the same as the farm stock ratios

Animal health supplements

Animal - Beef / dairy grazing

No animal supplementation has been entered

Left over feeding

No left over feeding specified

Stored supplements

No supplements from storage added to this farm

FarmParameters

Imported supplements

Supplement information

Conservation type	Silage
Name	Baleage
Supplement amount	
Number of bales	214
Packaging	Round bales
Bale size	
Standard bale equivalents	11

Fed on blocks: Kale
No timing of feeding has been specified

Report settings

Greenhouse gas emission report units: Use default
Target N application rate as effluent: kg N/ha/yr

Block Information

Block - Pastoral - Woodlands

Block name		Pastoral - Woodlands
Block type		Pastoral
Area	ha	87
Relative productivity		1
Pasture block type		Yes
Topography		Flat
Distance from coast	km	18
Cultivated in last 5 years		False
Fodder rotates through		Yes

Climate

Annual average rainfall	mm/yr	1152
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm, None to weak
Annual potential evapotranspiration	mm	775
Seasonal variation in PET		Moderate

Soil description

Soil order (default)		Brown
Soil group (default)		Sedimentary
SMaps		
Sibling		Wood_29a.1
Date downloaded		2016 July 14 15:47
Wilting point	0 - 30cm	21
	30 - 60cm	24
	> 60	24
Field capacity	0 - 30cm	41
	30 - 60cm	39
	> 60	41
Saturation	0 - 30cm	57
	30 - 60cm	50
	> 60	47
Natural drainage class		Imperfect
Depth to impeded layer	cm	Not entered
Maximum rooting depth	cm	Not entered
Top soil horizon chemical and physical parameters		
ASC/PR	%	43
Bulk density	kg/m³	1090
Clay	%	27
Sand	%	12
Sub soil		
Sub soil clay	%	29

Soil profile

FarmParameters

Profile drainage class		Imperfect
Top soil texture		Unknown
Maximum rooting depth	m	0
Depth to impeded drainage layer		0

Soil drainage

Drainage method		
Method		Mole/tile system
Percent of paddock drained		40
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False

Soil settings

K leaching (%s)	Medium
N immobilisation status	

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30	7	8	10	8

QT SO4	10
Anion storage capacity or phosphate retention	Not entered
TBK reserve K test	Not entered
K reserve status	Use default

Pasture

Pasture type	Ryegrass/white clover
Clover levels	Use default

Supplements removed

Supplement information	
Conservation type	Baleage
Name	
Wrapping	Wrapped in plastic
Supplement amount	
Number of bales	480
Packaging	Round bales
Bale size	
Standard bale equivalents	11
Fed on blocks: Kale	
No timing of feeding has been specified	

Fertiliser application

Fertiliser products - February		
Category		Ballance super
Product		Superten 15K (30% potash superten)
Amount	kg/ha	100
Fertiliser products - August		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	60
Fertiliser products - September		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	60
Fertiliser products - October		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	40
Fertiliser products - March		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	80
Fertiliser products - April		
Category		Ballance other

Product		N-rich urea
Amount	kg/ha	65
Fertiliser products - May		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	40

Irrigation

No irrigation entered

Animals on block

Ratio and type of stock based on whole farm values due to this option being selected on block set up

Animals grazing		
Beef / dairy grazing	%	0
Block intensity		
Finishing beef		False
Water connectivity		
Direct access to streams		False
Animal grazing		
Beef / dairy grazing graze block all year round		

Effluent application

Receives no liquid or solid effluents

Block - Pastoral - Dacre

Block name		Pastoral - Dacre
Block type		Pastoral
Area	ha	16
Relative productivity		1
Pasture block type		Yes
Topography		Flat
Distance from coast	km	18
Cultivated in last 5 years		False
Fodder rotates through		Yes

Climate

Annual average rainfall	mm/yr	1152
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm, None to weak
Annual potential evapotranspiration	mm	775
Seasonal variation in PET		Moderate

Soil description

Soil order (default)		Gley
Soil group (default)		Sedimentary
SMaps		
Sibling		Paro_4a.1
Date downloaded		2016 July 14 15:48
Wilting point	0 - 30cm	14
	30 - 60cm	16
	> 60	17
Field capacity	0 - 30cm	47
	30 - 60cm	43
	> 60	46
Saturation	0 - 30cm	63
	30 - 60cm	52
	> 60	53
Natural drainage class		Poor
Depth to impeded layer	cm	Not entered
Maximum rooting depth	cm	Not entered
Top soil horizon chemical and physical parameters		
ASC/PR	%	35
Bulk density	kg/m³	940
Clay	%	25
Sand	%	9

FarmParameters

Sub soil		
Sub soil clay	%	26
Soil profile		
Profile drainage class		Poor
Top soil texture		Unknown
Maximum rooting depth	m	0
Depth to impeded drainage layer		0
Soil drainage		
Drainage method		
Method		Mole/tile system
Percent of paddock drained		60
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False
Soil settings		
K leaching (%s)		Medium
N immobilisation status		Standard

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30	7	8	10	8

QT SO4		10
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default
Pasture		
Pasture type		Ryegrass/white clover
Clover levels		Use default
Supplements removed		
No supplements removed from this block		
Fertiliser application		
Fertiliser products - February		
Category		Ballance super
Product		Superten 15K (30% potash superten)
Amount	kg/ha	100
Fertiliser products - August		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	60
Fertiliser products - September		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	60
Fertiliser products - October		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	40
Fertiliser products - March		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	80
Fertiliser products - April		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	65
Fertiliser products - May		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	40

FarmParameters

Irrigation

No irrigation entered

Animals on block

Ratio and type of stock based on whole farm values due to this option being selected on block set up

Animals grazing		
Beef / dairy grazing	%	0
Block intensity		
Finishing beef		False
Water connectivity		
Direct access to streams		False
Animal grazing		
Beef / dairy grazing graze block all year round		

Effluent application

Receives no liquid or solid effluents

Block - Kale

Block name		Kale
Block type		Fodder Crop
Rotation area	ha	20
Low N mineralisation		False
Final grid month		November
Irrigation system type		No Irrigation

Crop information

Current assessment year 15/16

December - Kale		
Crop management	See details below	Crop sown
Fertiliser or lime added	See details below	
January - Kale		
February - Kale		
Fertiliser or lime added	See details below	
March - Kale		
Fertiliser or lime added	See details below	
April - Kale		
May - Kale		
June - Kale		
Crop management	See details below	Defoliation
July - Kale		
Crop management	See details below	Defoliation
August - Kale		
Crop management	See details below	Defoliation
September - Bare ground		
October - Bare ground		
November - Grazed		
Crop management	See details below	Crop sown

Crop sowing information - December of the Current assessment year 15/16

Crop category		Fodder
Crop type		Kale
Product yield	T/ha dry matter	12
Cultivation practice at sowing		Conventional

Defoliation information - June of the Current assessment year 15/16

Defoliation method		Grazed in-situ
Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered

Defoliation information - July of the Current assessment year 15/16

Defoliation method		Grazed in-situ

FarmParameters

Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered

Defoliation information - August of the Current assessment year 15/16

Defoliation method		Grazed in-situ
Final harvest		True
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Beef / dairy grazing	%	100
Crop grazed for	hours/day	Not entered

Crop sowing information - November of the Current assessment year 15/16

Crop category		Permanent pasture
Crop type		Grazed
Source of animals		Not entered

Fertiliser application

Fertiliser products - Current assessment - December (N Method: Incorporated)

Category		Ballance cropping
Product		Cropzeal boron boost
Amount	kg/ha	250

Fertiliser products - Current assessment - February (N Method: Surface applied)

Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100

Fertiliser products - Current assessment - March (N Method: Surface applied)

Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100

Effluent application

Receives no liquid or solid effluents

Block - Non productive

Block name		Non productive
Block type		Trees and Scrub
Area	ha	7
Rainfall	mm/yr	1152
Distance from coast	km	18
Bush type		Native

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H & S Schrader

Miranda Hunter
Roslin Consultancy Limited

Client reference:

Farm name: Schrader - Current Farm - v 6.2.3 (15/16)

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
				(kg/ha/yr)			
Nutrients added							
Fertiliser, lime & other	144	14	11	6	12	0	0
Rain/clover N fixation	72	0	3	6	4	8	44
Irrigation	0	0	0	0	0	0	0
Supplements imported	7	1	9	1	2	1	1
Nutrients removed							
As products	61	15	4	7	31	1	2
Exported effluent	0	0	0	0	0	0	0
As supplements	0	0	0	0	0	0	0
To atmospheric	69	0	0	0	0	0	0
To water	40	0.4	8	13	54	11	30
Change in internal pools							
Plant material	-6	-1	-22	5	-1	-2	-1
Organic pool	25	7	2	-13	1	0	0
Inorganic mineral	0	4	-24	0	-2	-3	-3
Inorganic soil pool	34	-10	54	0	-65	1	16

H & S Schrader

Miranda Hunter
Roslin Consultancy Limited

Client reference:

Farm name: Schrader - Current Farm - v 6.2.3 (15/16)

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Pastoral - Woodlands ##	1939	28	6.3	155	159
Pastoral - Dacre ##	286	22	5.2	171	159
Kale	2100	105	**18.8**	205	133
Non productive	21	3	N/A		
Other farm sources	41				
Whole farm	4388	40			
Less N removed in wetlands	0				
Farm output	4388	40			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Has a fodder crop rotating though, results for pastoral block component only

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Version 6.2.3, on 2016-11-17 04:40:37

H & S Schrader

Miranda Hunter
Roslin Consultancy Limited

Client reference:

Farm name: Schrader - Current Farm - v 6.2.3 (15/16)

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Pastoral - Woodlands ##	19	0.3	Low	Low	n/a
Pastoral - Dacre ##	6	0.5	Low	Low	n/a
Kale	9	0.5	n/a	n/a	n/a
Non productive	1	0.1	n/a	n/a	n/a
Other farm sources	11				
Whole farm	47	0.4			

Has a fodder crop rotating though, results for pastoral block component only

ATTACHMENT C MONTHLY CHECK SHEET

Schrader Mains Limited

Monthly Check Sheet

On a monthly basis the following checks and measures must be undertaken. The details of the monthly check shall be recorded on this sheet, and at the completion of the inspection the sheet shall be filed for future reference. If there are any matters requiring follow up work i.e. you note that an effluent nozzle needs replacing, please make a note of these, and ensure that the actions are followed up immediately.

Date:...

Employee:...

☐ Record volume of water abstraction ....

☐ Clean stone traps.

Any further actions required? Y/N

Explanation...

☐ Check all inlet and outlet pipes to storage ponds/sumps to ensure they are free of debris to prevent blockages.

Any further actions required? Y/N

Explanation...

☐ Check the stone trap is clear of solid material. If necessary arrange to clear out the sump.

Any further actions required? Y/N

Explanation...

☐ Check the level of solids, if necessary arrange for solids bed to be emptied when conditions are appropriate.

Any further actions required? Y/N

Explanation...

☐ Check effluent nozzles are clear and in good working order

Any further actions required? Y/N

Explanation...

☐ Check effluent irrigator pipe is in good working order and does not have any leaks

Any further actions required? Y/N

Explanation………

☐ Check well-head(s) remain capped.

Any further actions required? Y/N

Explanation………

ATTACHMENT D EFFLUENT DISPOSAL RECORD

Irrigator run sheet

- ☑ Check the records to ensure effluent is due to be applied to that particular area
- ☑ Allow a minimum interval of 10 days between applications and grazing for animal health
- ☑ Ensure irrigator will be applying effluent to short pasture.

Date	*Paddock*	*Run*	*Name*	*Comments*

dairynz.co.nz
0800 4 DairyNZ (0800 4 324 7969)

You can use your Fonterra Dairy Diary as an alternative to this form, or photocopy a farm map – draw and date the runs on the copy then file it.

ATTACHMENT E TRAINING GUIDE

Effluent Orientation and Training Record

Season___/___

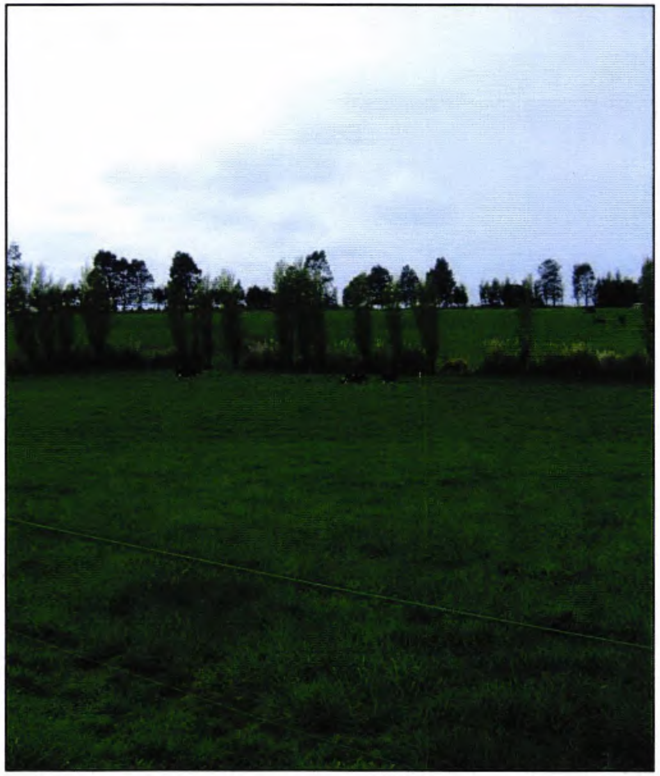
Effluent Competencies	Employee name	Employee name	Employee name
General			
Understands the regional council rules and farm policies for effluent management			
Understands health and safety around the effluent system			
Understands record keeping for irrigator runs and maintenance			
At the Dairy			
Use of stormwater diversion system			
Good hosing practice and water management			
Animal handling to minimise effluent volume			
Cleaning the stone trap			
Sump, pump & pond monitoring and management (including float switches)			
In the Paddock			
When to irrigate: assessing soil and weather conditions			
Where to irrigate: runs, paddock rotations, high risk vs low risk soils etc (mark on farm map)			
Where not to irrigate: near waterways, drains, boundaries, slopes etc (mark on farm map)			
How the irrigator works, how to use it, set up, hose layout and performance checks			
Measuring the depth of effluent application			
Irrigator, pump maintenance/cleaning			
Greasing and general maintenance requirements (how and when)			
How to check and replace rubber nozzles and seals (same time as dairy rubber ware)			
Tyre pressure and condition			
Pipe-work, hose and hydrant condition			
Wire-rope, cam and ratchet condition			
Other			

Trainer signature			
Employee signature			
Date			

Date when staff become competent in each skill. If all training provided in one day, tick and date at the bottom.

DairyNZ

Attachment C – Farm Management Plan



SCHRADER MAINS LIMITED

FARM ENVIRONMENTAL MANAGEMENT PLAN – January 2016

Plan Version	Date	Next Review
Rev A	January 2017	January 2018

Contents

Appendices

Appendix A	FEMP Site Plan
Appendix B	Resource Consents
Appendix C	Intensive Winter Grazing Areas 2017/18
Appendix D	Effluent System Records
Appendix E	Nutrient Budgets

A: Property Overview

Contact Person(s):	Hank & Sandra Schrader	Farm Name:	-	Plan Prepared By:	Landpro Limited
Physical Address:	514 Rimu Seaward Downs Road, Waituna	Farm Manager (if different):	N/A	Date:	January 2017
Email Address:	schrader@woosh.co.nz	Email Address:	-	Date of Next Review:	January 2018
Contact Phone:	03 239 5528 or 0274 08 0962	Contact Phone:	-	Milk Supply Number:	N/A
Person Responsible for Implementing Farm Plan:		Hank & Sandra Schrader			

This FEMP sets out the management practices that will be implemented and adopted to actively manage the operation of the property as a dairy farm, so as to ensure that environmental risks are identified and managed appropriately and resource consent conditions complied with. This plan has been prepared in accordance with the requirements of Appendix N Proposed Southland Water and Land Plan.

Objectives of this plan:

- Comply with all legal requirements related to nutrient management, land use and discharge activities.
- Take all practicable steps to maintain or enhance the quality of the property's water resources.
- Take all practicable steps to ensure that there is an adequate supply of soil nutrients to meet plant needs.
- To take all practicable steps to contain nutrients within the property boundaries.
- Take all practicable steps to minimise the risk of nutrient contamination of any areas of significant vegetation and/or wildlife habitat
- Identify and utilise GMP's that will be adopted to achieve the above objectives.

This will be achieved through;

- Identifying and documenting contaminant pathways for the property (based on 'Gleyed' Physiographic Zone information)
- Identify and document environmental risks (nutrients and sediment) for the property
- Identify relevant good management practices (GMP) and where they are required to be implemented to minimise environmental risks
- Keep records to show adherence with good management practices
- Document a water monitoring protocol to ensure that water quality is maintained or improved
- Document the nutrient budgeting protocol to ensure consistency with predicted losses at the time consent was sought
- Ensure compliance with resource consents
- Document clear reporting and compliance procedure to provide certainty

As the person responsible for implementing this plan, I confirm that the information provided is correct:

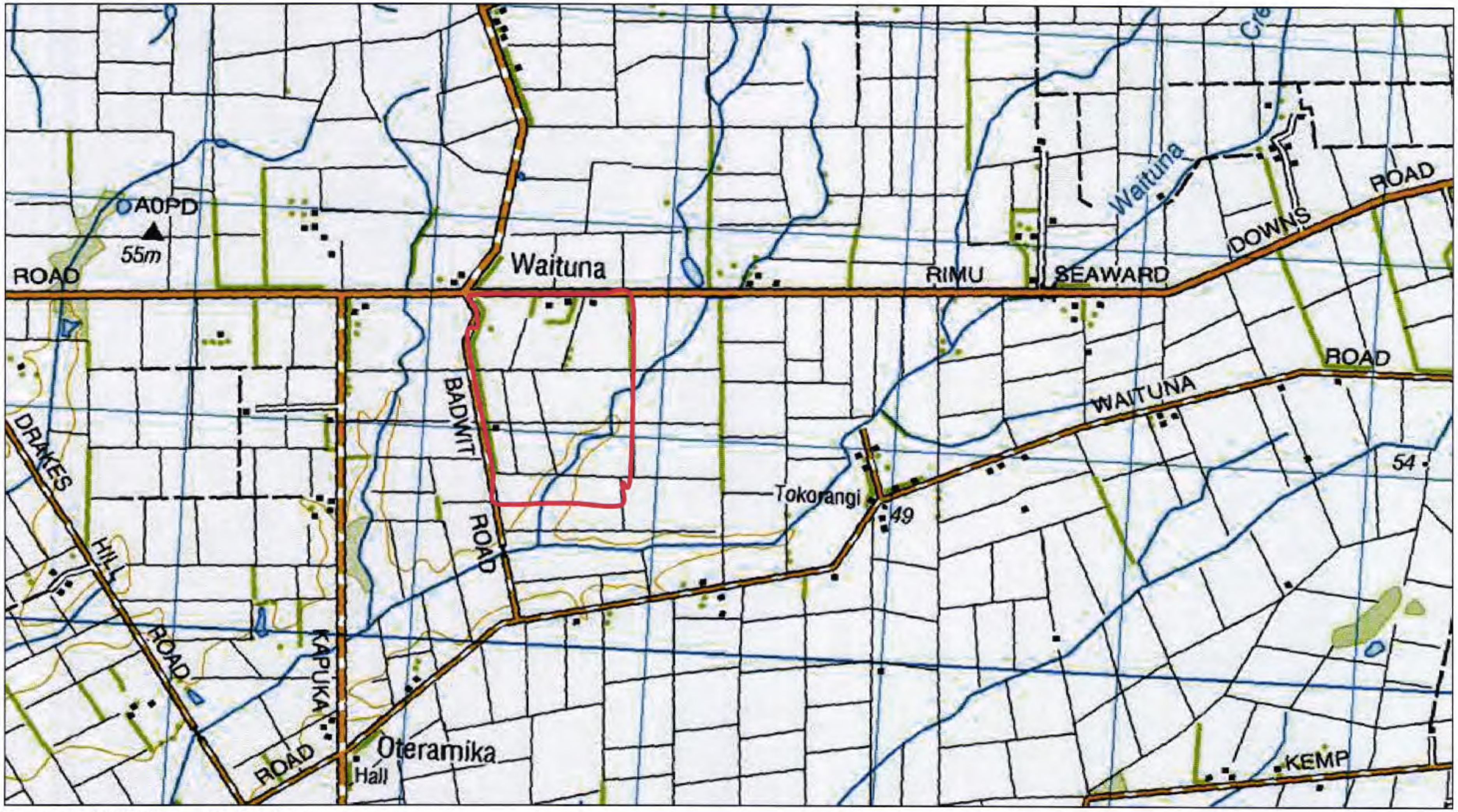
Name: Hank & Sandra Schrader

Date: 11 January 2017

Signed:

Legal Description:	Section 7 and Section 49 Block II Oteramika Hundred and Lot 1 DP 12478	(ha)	77.27	Catchment:	Waituna Creek
	Part Section 5-6 Oteramika Hundred	(ha)	33.48	Peak Herd Size:	306 Cows
Total Effective Area (ha):	103 ha	Total Farm Area (ha)	110.75	Stocking Rate:	2.97 cows/ha (effective area)
Cows Wintered On:	Not applicable	Crop Area (ha):	2ha	Crop Type:	Kale
Soil Type:	Woodlands	Area (ha):	92.4 ha		
	Dacre	Area (ha)	17.6 ha		
Physiographic Zone	Gleyed (no variant)	Area (ha)	110.75		

Figure 1: Property Location Plan



Source: LINZ Topo 50 Series

B: Environmental Risk Assessment

The environmental risks for the property have been identified as nutrient (Nitrogen and Phosphorous) and sediment loss from Critical Source Areas via overland flow and artificial drains. There is a low risk of excessive nitrate leaching to groundwater, due to cation exchange and chemical sorption processes within the soil profile.

Critical Source Areas (CSA's) refer to smaller areas within a larger area, where there is disproportionally high loss of pollutants. The dominance of these small areas is dependent on many factors, including soil type, topography, management (such as fertiliser and manure inputs) and transport processes (such as rainfall and artificial drains).

The following sections identify how CSA's will be managed and monitored to minimise environmental risk to receiving water bodies.

Given the environmental setting and main transport pathways (i.e. overland flow and artificial drainage), the highest risk periods are in association with storm events. Contaminant loss during these periods will be avoided by using low rate, deferred effluent irrigation along with stock exclusion from waterways and the use of buffer zones and riparian planting around streams will reduce nutrient loss. Excessive nutrient loss will be avoided by managing supplements and fertiliser in accordance with a nutrient budget and through the use of a feedpad/standoff pad which will minimise urine deposits on grazed crops.

C: Resource Consents

Note: As at the date of this plan [11 January 2017] resource consents have not been granted to facilitate the conversion of the land to dairy. However, this section has been prepared on the basis of the consents which have been sought, and the draft conditions promoted by Schrader Mains Limited, and will be updated upon the granting of consent to reflect actual conditions of consent/expiry dates etc.

Resource consents have been granted to Schrader Mains Limited as set out in Table 1 below. A copy of the resource consents for the property are attached as Appendix B.

Table 1: Summary of Resource Consents held by Schrader Mains Ltd

Consent Number	Consent Type	Description of Activity	Consent Expiry Date
XX	Land Use Consent – Bore Consent	To construct a groundwater bore	February 2021
XX	Land Use Consent – Pond Storage	To construct and effluent storage pond	February 2021
XX	Water Permit	To abstract groundwater for Stock and Shed Water Purposes	February 2031
XX	Land Use Consent – To Establish a Dairy Farm	To convert the land for use as a dairy farm	February 2031
XX	Land Use Consent – To use land for dairying	For the ongoing use of land for dairy farming	February 2031
XX	Discharge Permit	To discharge agricultural effluent to land from a dairy shed and feedpad/standoff pad	February 2031

These resource consents have been granted subject to a suite of conditions which the consent holder is required to comply with at all times during the term of the consent. This FEMP whilst a condition of consent is also written with the express purpose of enabling the consent holder to comply with the terms and conditions of the consent, and to keep the necessary records to demonstrate compliance.

D: Land Management

D.1 Physiographic Zones

This section of the FMP documents the physiographic zone(s) of the property, and identifies the GMPs currently undertaken and opportunities for management practices which will mitigate effects on water quality. The property is wholly located within the Gleyed (no variant) Physiographic Zone.

Table 2: Key transport pathways and contaminants for each physiographic zone

Physiographic Zone	**Key Transport Pathways (✓)**		
	Overland Flow[1]	**Deep Drainage (leaching to groundwater)[2]**	**Artificial Drainage[1]**
Gleyed	✓		✓

[1] *Overland flow and artificial drainage transport nitrogen, phosphorous, and microbes and sediment*

[2] *Deep drainage transports nitrogen*

The key transport pathways for the property are identified as nitrogen, phosphorous, microbes and sediment loss from Critical Source Areas via overland flow and artificial drains within the Gleyed Zone. There is a low risk of excessive nitrate leaching to groundwater.

Given the environmental setting and main transport pathways (i.e. overland flow and artificial drainage within the Gleyed zone), the highest risk periods are in association with sustained, or heavy rainfall, typically between May and the end of July when soils are near field capacity. Contaminant loss during these periods will be avoided by using low rate, deferred effluent irrigation along with stock exclusion from waterways and the use of buffer zones and riparian planting around streams which will reduce nutrient loss. Excessive nutrient loss will be avoided by managing supplements and fertiliser in accordance with a nutrient budget.

D.2 Soils

This section of the FEMP documents the soil types of the property, and identifies what good management practices will be adopted to ensure that the identified soil vulnerabilities are minimised. The property contains both Woodlands and Dacre Soils as shown in Figure 2. Woodlands soils comprise approximately 84% of the property, while Dacre Soils make up the remaining 16% of the property. In terms of the properties of these soils both are considered to be 'high risk' in terms of FDE management, and are classified as having the following soil vulnerability factors;

Table 3: Soil Vulnerability Factors

Soil Type	**Vulnerability Factor**		
	Structural Compaction	**Nutrient Leaching**	**Water Logging**
Dacre Soils	Moderate	Slight	Severe
Woodlands Soils	Moderate	Slight	Moderate

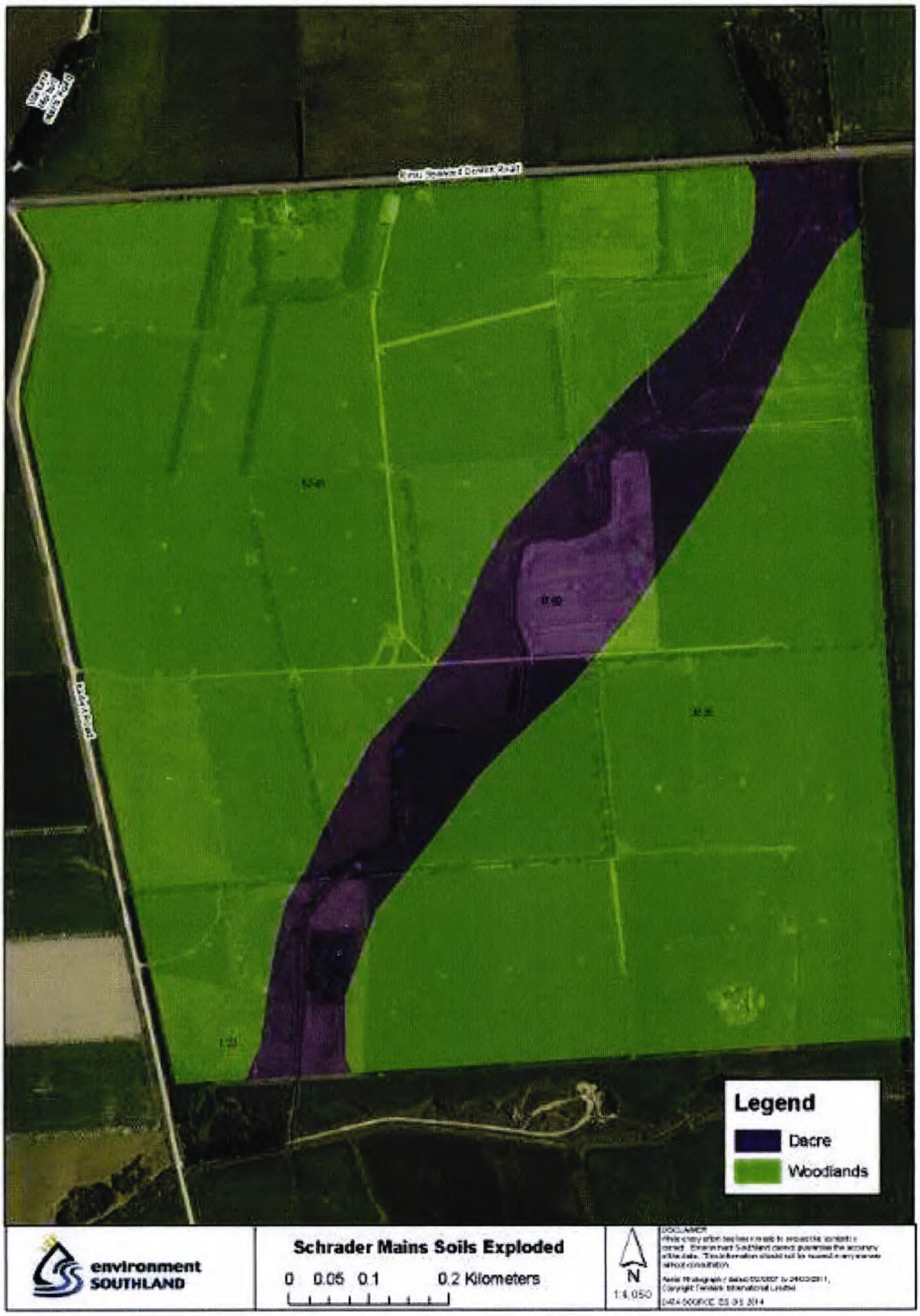
Good Management Practices to be adopted include;

Table 4: Soil Good Management Practices

Good Management Practice	Mitigation Aims	Location	Method
Sediment loss from the farm will be minimised where required with the use of sediment traps and bunds.	- Capture nutrients sediment and microbes in wetlands and sediment traps. - Protect soil structure, particularly in gullies and near stream areas.	At Critical Source Areas i.e. at the end of swales especially during grazing on the shoulders of the season.	Haybales or Sediment Fence.
Use of Standoff Pad/Feed Pad to minimise compaction during extensive rainfall events.	- Protect soil structure, particularly in gullies and near stream areas.	Standoff Pad/Feed Pad.	In periods of high rainfall cows will be removed from pasture and stood on the feedpad/standoff pad to minimise damage to pasture and soil structure.
Temporary fencing of Critical Source Areas and swales to minimise compaction of soils and potential for overland flow of sediment to waterways.	- Manage Critical Source Areas.	Critical Source Areas.	Temporary fencing/grazing management
Strategic grazing	- Reduce the accumulation of surplus N in the soil	At Critical Source Areas.	Methods as outlined in *Dairy NZ Wintering in Southland and Otago* will be adopted in selecting appropriate paddocks for

Good Management Practice	Mitigation Aims	Location	Method
	particularly during autumn. • Nutrient management. • Protect soil structure, particularly in gullies and near stream areas. • Manage Critical Source Areas.		establishing crops, providing filtering buffers from overland flow, planning grazing etc.

Figure 2: Schrader Mains Soil Classification Plan



D.3 Artificial Drainage

Due to the imperfectly drained nature of the property, it is underlain by artificial drainage, primarily in the form of tile drains. These drains are of mixed age, and are located at varying depths from 1 to 1.5 metres throughout the property. Tile drains have been identified as a key environmental risk for this property in respect to manging effects on water quality, and nutrient loading as detailed in Section B FEMP.

The location of tile drains on the property have been identified and are shown on the FEMP Site Plan attached as Appendix A.

Good Management Practices which will be adopted to minimise the effects associated with artificial drainage include;

Table 5: Artificial Drainage Good Management Practices

Good Management Practice	Mitigation Aims	Location	Method
Low rate and deferred effluent irrigation.	• Avoid preferential flow of effluent through drains. • Reduce accumulation of surplus N in the soil, particularly during autumn. • Effluent management.	Effluent disposal area & FDE infrastructure	Deferred storage of effluent is provided to enable application of effluent during optimum periods when there is reduced or no risk of discharge to tile drains from application of effluent. Application of effluent at low rates (as defined in the FDE Section) will also reduce the risk of overland flow of effluent and subsequent discharge to surface water.
Fertilising outside of high risk periods.	• Reduce accumulation of surplus N in the soil,	Whole Farm	Weather forecast will be considered prior to the application of fertiliser and if high

Good Management Practice	Mitigation Aims	Location	Method
	particularly during autumn. • Reduce P use or loss. • Nutrient Management. • Manage Critical Source Areas.		intensity rainfall is forecast to occur application will be deferred.
Ensuring soil P levels are not high.	• Reduce P use or loss. • Nutrient Management. • Manage Critical Source Areas. • Effluent Management	Whole Farm	Annual soil tests will be undertaken to measure Olsen P levels in soils, and monitoring of potential P losses will be undertaken as set out in Section F1 FEMP.
Restricted grazing when soils are wet.	• Protect soil structure, particularly in gullies	Whole Farm	During periods of high intensity rainfall, where ponding and overland flow are or are likely to occur restricted grazing

Good Management Practice	Mitigation Aims	Location	Method
	and near stream areas. • Manage Critical Source Areas. • Reduce accumulation of surplus N in the soil, particularly during autumn.		techniques (as discussed in this FEMP and Dairy Z guidelines) will be implemented. This may include the use of the standoff pad during such events.

Baseline monitoring will be undertaken and once completed, results of monitoring will be utilised to review and assess the effectiveness of land management techniques to minimise nutrient loss by artificial drainage. If monitoring indicates that there is an increase in nutrient loss land management techniques will be amended.

D.4 Critical Source Areas

Critical Source Areas for the property have been identified in conjunction with the Environment Southland Land Sustainability Team, and include;

- Swale areas located around the point of discharge from tile drains;
- Bridge Crossing Approaches;
- Laneways and Races.

Critical Source Areas are shown in the FEMP Site Plan attached as Appendix A. Good Management Practices will be adopted to manage high risk Critical Source Areas as set out in Table 6 below. Reference documents used to identify GMP's include *Environment Southland Fact Sheet*

– *Critical Source Areas* and in *Dairy NZ Wintering in Southland and Otago* and in *Dairy NZ Land Management on Canterbury Dairy Farms – Managing land to reduce sediment and phosphorus loss.*

Table 6: Critical Source Areas Good Management Practices

Good Management Practice	**Mitigation Aims**	**Location**	**Method**
Restricted grazing when soils are wet.	• Protect soil structure, particularly in gullies and near stream areas. • Manage Critical Source Areas. • Reduce accumulation of surplus N in the soil, particularly during autumn. • Reduce P use or loss. • Avoid preferential flow of effluent through drains.	Whole Farm.	During periods of high intensity rainfall, where ponding and overland flow are or are likely to occur restricted grazing techniques (as discussed in this FEMP and Dairy NZ guidelines) will be implemented. This may include the use of the standoff pad during such events.
Minimum or no-till cultivation.	• Protect soil structure, particularly in gullies and near stream areas. • Manage Critical Source Areas.	Crop Paddocks and Re-grassing Areas.	Where appropriate techniques such as direct drilling will be utilised to minimise the potential for discharge to surface water via Critical Source Areas.

Good Management Practice	Mitigation Aims	Location	Method
Avoiding areas of bare land or damaged soils.	• Protect soil structure, particularly in gullies and near stream areas. • Reduce accumulation of surplus N in the soil, particularly during autumn. • Manage Critical Source Areas.	Whole Farm.	Strategic grazing techniques, feedpad/standoff pad and temporary fencing are all methods that will be utilised to avoid areas of bare land or to minimise effects of compaction of soils.
Identification of Tile Drains.	• Manage Critical Source Areas. • Avoid preferential flow of effluent through drains. • Capture contaminants at drainage outflows. • Effluent Management • Capture nutrients sediment and microbes in wetlands and sediment traps.	Whole Farm.	Apply low depths of effluent (i.e. less than 10mm depth) so nutrients can be assimilated by soils within the top soil water deficit.

Good Management Practice	Mitigation Aims	Location	Method
Appropriate construction of Laneways.	• Manage Critical Source Areas.	Laneways.	Tracks and laneways have been sited away from waterways where possible with the camber directing run-off to land to ensure no overland flow of effluent into McMillian Creek. The existing bridge abutments are to be upgraded to ensure effluent is directed off the bridge to land and not able to discharge directly into water.
Identification of culvert crossings and appropriate construction.	• Manage Critical Source Areas. • Riparian Management.	Whole Farm.	There is one major bridge crossing and three culvert crossings as shown on the site plan in Appendix A.
Swale Management.	• Manage Critical Source Areas. • Capture nutrients sediment and microbes in wetlands and sediment traps. • Effluent Management • Capture contaminants at drainage outflow.	Critical Source Areas.	Identify swale areas prior to grazing and cultivation of land and prior to the application of effluent, and retain grass buffers where necessary. Utilise temporary fencing to keep stock off swale areas during periods of sustained heavy rainfall. Utilise the feedpad/standoff pad particularly on the shoulders of the season. Investigate methods for treating

Good Management Practice	Mitigation Aims	Location	Method
	• Avoid preferential flow of effluent through drains.		tile drain outflow i.e. wetlands or other sediment trap options.

D.5 Grazing Management

Grazing Management is an important tool for minimising the effects of grazing on soil and for reducing the potential for the discharge of sediment and other contaminants to water. Grazing Management techniques which will be employed to reduce risks particularly in proximity to artificial drainage areas and CSA's include;

- Pugging damage will be minimised by avoiding high risk areas (Critical Source Areas and artificial drainage) during risky weather events (i.e. snow/rain). This will be achieved through measures such as temporary fencing and use of the feedpad/standoff pad.
- Feeding supplementary feed away from waterways and Critical Source Areas.
- No winter grazing (between 1 June – 31 July)
- Leaving grass buffer strips when grazing animals on crop.
- Restricted grazing of sloping land from the top of the slope to the bottom of the slope.

Table 7: Grazing Management Good Management Practices (Currently undertaken and proposed to continue to be undertaken)

Good Management Practice	Mitigation Aims	Location/Zone	Method
Sediment loss from the farm will be minimised where required with the use of sediment traps and bunds.	• Manage Critical Source Areas.	At Critical Source Areas i.e. at the end of swales especially during the shoulders of the season.	Haybales or Sediment Fence. Riparian planting and maintenance of grass buffers will

Good Management Practice	Mitigation Aims	Location/Zone	Method
	• Capture nutrients sediment and microbes in wetlands and sediment traps. • Riparian Management • Effluent Management • Reduce P use or loss.		help reduce sediment in the event of overland flow episodes.
Minimise periods of exposed soil.	• Protect soil structure, particularly in gullies and near stream areas. • Reduce accumulation of surplus N in the soil, particularly during autumn and winter. • Manage Critical Source Areas. • Capture nutrients sediment and microbes in wetlands and sediment traps. • Riparian Management	Cropped paddocks.	Re-sow harvested crop areas as soon as practical to reduce sediment and nutrient loss.

Good Management Practice	Mitigation Aims	Location/Zone	Method
Consider soil conditions in the crop rotation and be ready to adjust rotation if soil condition is unsuitable for cropping (i.e., soil is compacted).	• Protect soil structure, particularly in gullies and near stream areas. • Manage Critical Source Areas. • Capture nutrients sediment and microbes in wetlands and sediment traps.	Whole Farm.	Check over paddocks prior to cropping to assess suitability for cropping (i.e. slope, compaction, distances to nearby waterways).
Reduce soil erosion.	• Manage Critical Source Areas. • Riparian Management • Protect soil structure, particularly in gullies and near stream areas.	Gateways and laneways.	Maintain laneways, and gravel in gateways.

D.6 Intensive Winter Grazing

Intensive winter grazing is an important element of the farm system, i.e grazing stock in-situ during August/September. Under the proposed conversion not more than 2 hectares will be planted in crop in any given year. [Note: Once cropped areas for coming season are identified, these will be marked on the farm map and recorded in the farm diary].

The risks associated with winter grazing are characterised by the physiographic zone; resulting in two key contaminant pathways for the property; Overland Flow and Artificial Drainage. The Good Management Practices to be adopted on the property to manage the effects of grazing in-situ on crop are set out in Table 8 below;

Table 8: Intensive Winter Grazing Good Management Practices (Currently undertaken and proposed to continue to be undertaken)

Good Management Practice	Mitigation Aims	Location/Zone	Method
Paddock Selection and Setup.	• Manage Critical Source Areas. • Capture nutrients sediment and microbes in wetlands and sediment traps. • Riparian Management • Effluent Management • Reduce P use or loss.	Whole Farm.	When planning which paddocks will be used for intensive winter grazing consider the location of waterways and Critical Source Areas. Provide and maintain pasture buffer strips between crop areas and waterways and swales.
Nutrient Management.	• Nutrient Management • Manage Critical Source Areas	Whole Farm.	Undertake paddock specific soil testing to match nutrients to demand. Use low solubility P fertiliser
Grazing Management.	• Manage Critical Source Areas.	Whole Farm.	Haybales or Sediment Fence. Riparian planting and maintenance of grass buffers will be used to help reduce sediment

Good Management Practice	Mitigation Aims	Location/Zone	Method
	• Capture nutrients sediment and microbes in wetlands and sediment traps. • Riparian Management • Effluent Management • Reduce P use or loss. • Protect soil structure, particularly in gullies and near streams.		in the event of overland flow episodes. Employ strategic grazing techniques such as back fencing, grazing towards Critical Source Areas and utilise standoff pad/feed pad.

D.7 Cultivation

Cultivation is undertaken on the property as part of planting areas of crop (up to 4 hectares under the proposed conversion) and as part of an overall re-grassing program employed on the property. The effects of cultivation activities will be managed through the continued adoption of the following GMP's;

Table 9: Cultivation Good Management Practices (Currently undertaken and proposed to continue to be undertaken)

Good Management Practice	Mitigation Aims	Location/Zone	Method
Paddock Selection and Setup.	• Manage Critical Source Areas.	Whole Farm.	When planning which paddocks will be cultivated consider the location of waterways and Critical Source Areas. Provide and

Good Management Practice	Mitigation Aims	Location/Zone	Method
	• Capture nutrients sediment and microbes in wetlands and sediment traps. • Riparian Management • Effluent Management • Reduce P use or loss.		maintain pasture buffer strips between cultivated areas and waterways and swales.
Buffer Strips.	• Manage Critical Source Areas. • Capture nutrients sediment and microbes in wetlands and sediment traps. • Riparian Management	Whole Farm	Provide buffer strips along water bodies; • 3m slopes 4 degrees or less • 10m on slopes 4 – 16 degrees • 20m on slopes greater than 16 degrees.

D.8 Farm Infrastructure

Farm Infrastructure Areas will be managed so as to minimise the risk of unauthorised discharges to land or water. High Risk farm infrastructure areas include;

- The Cowshed
- The Feedpad/Standoff Pad
- Silage Pits
- Effluent Ponds

- Calf Shed
- Chemical Shed
- Implement Shed & Fuel Depot

Good Management Practices which will be employed to manage high risk farm infrastructure areas are summarised in Table 10 below; A full list of references in respect to Good Management Practices is provided in Section L FEMP.

Table 10: Farm Infrastructure Good Management Practices

Good Management Practice	Mitigation Aims	Location	Method
Cowshed.	• Effluent Management.	Cowshed	At the cowshed, stone traps and sumps will be checked weekly, and clean stormwater will be diverted from the shed roof to minimise the volume of water entering the effluent storage pond.
Feedpad/Standoff Pad.	• Effluent Management. • Manage Critical Source Areas. • Protect soil structure, particularly in gullies and near stream areas.	Feedpad/Standoff Pad	The feedpad/standoff pad will be designed to capture all effluent and divert this to the effluent management system so as to avoid unauthorised discharges to land or water.
Silage Pits.	• Effluent Management. • Manage Critical Source Areas.	Silage Pits.	Silage Pits will be located so as to ensure that there is no discharge of silage pit leachate to land or water. Any

Good Management Practice	Mitigation Aims	Location	Method
			hardstand silage pit areas will be directed to the effluent storage pond.
Effluent Ponds	- Effluent Management.	Effluent Ponds	The effluent pond will be designed and certified by an appropriately qualified person. The effluent pond will also be fenced and checked for leakage during monthly inspections (or at other frequency as directed by the pond design specifications).
Calf Shed	- Effluent Management. - Unintended discharge to the environment.	Calf Shed	Clean out the calf shed on annual basis and dispose of any solids outside of period 1 May to 30 September in any given year. Ensuring that milk lines are secure and that there are no leaking fittings.
Chemical Shed	- Unintended discharge to the environment.	Chemical Shed	Ensure that all chemicals are stored in accordance with HSNO requirements, including separation distances and bunding requirements. Ensure that chemical shed is locked at all times.

Good Management Practice	Mitigation Aims	Location	Method
Implement Shed & Fuel Depot	- Unintended discharge to the environment.	Implement Shed	Ensure that when refuelling machinery that drip pans are used and hoses are returned to bowsers to avoid discharges of fuel to land. Ensure that when maintaining vehicles that waste oil is collected and disposed of.

E: Water Way Management

E.1 Surface Water

The property is located in the Waituna catchment[1] and has unnamed tributaries to Waituna Creek flowing in a northeast to southwest direction through the applicants' property, as shown in the FEMP Site Plan attached as Appendix A. The Waituna Creek discharges into the Waituna Lagoon which is an intermittently closed and open coastal lake and lagoon (ICOLL) located approximately 10 kilometres (km) east of Invercargill.

The key receiving environments from the property are:

- an un-named tributary to Waituna Creek [locally known as McMillan Creek] which runs through the centre of the property;
- groundwater underneath the property which is part of the Waihopai groundwater management zone and has been characterised as being part of the Northern Waituna Zone. This groundwater discharges into Waituna Creek with a likely minor component providing throughflow into the lower reaches of the Waituna catchment;

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[1] The 'Waituna catchment' refers to the catchment area that drains into the Waituna Lagoon (i.e. Waituna, Moffat and Curran's Creeks) while the 'Waituna Creek catchment' refers solely to the drainage area associated with Waituna Creek.

- the Waituna Creek which receives groundwater discharge and flow from the tributary running through the property; and,
- the Waituna Lagoon which is an ICOLL that drains the Waituna, Moffat and Curran's Creek catchments.

E.2 Groundwater

The property is located within the Awarua Groundwater Zone. Generally, groundwater quality within the Awarua Groundwater Zone complies with limits set in the Drinking Water Standards for New Zealand (DWSNZ).

The 2010 State of the Environment (SOE) monitoring report[2] showed that of the 78 bores sampled in the Waihopai groundwater zone, the median nitrate concentration was 0.25 mg/L which is well below the DWSNZ maximum acceptable value of 11.3 mg/L. This indicates groundwater quality in this zone is very good which is interpreted to reflect the relatively large assimilative capacity of groundwater resources in this zone due to denitrification and/or attenuation processes.

Overall, based on the hydrogeological characteristics of the Waituna Catchment there is relatively low risk of nitrate concentrations accumulating in groundwater to levels that exceed the maximum acceptable value (excluding point-source discharges), however as set out in Section I annual Groundwater Monitoring will be undertaken to determine the effects of the activities on groundwater and the potential for accumulation of nitrate.

Groundwater use will also be recorded through the installation of a water meter and data logger as set out in the anticipated conditions of consent.

E.3 Fencing of Waterways

The primary waterway (McMillan Creek) which dissects the property is permanently fenced from stock with a minimum 3 meter buffer zone. 3 metres is measured horizontally from the outside edge of the wet bed of the creek, on both sides of the creek. Site inspection by Environment

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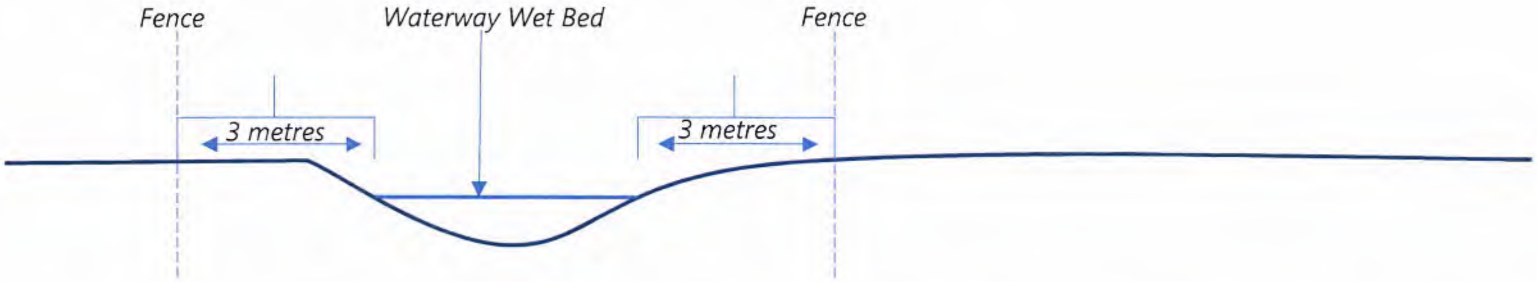
[2] Hughes, B. N., 2010. State of the Environment: Groundwater quality technical report. Prepared for Environment Southland by Liquid Earth Limited.

Southland has identified 2 – 3 areas where the fence is closer than 3 metres from the centre line of the bed of the creek. In these locations the fence will be shifted prior to the conversion of the property to ensure that the minimum buffer zone is maintained.

Figure 3: Fencing Buffer Zone Diagram



Where appropriate and as part of good grazing management, temporary fencing will be erected to prevent any point source discharges occurring. This includes fencing off swale areas where they may directly discharge to surface water. Such practices will be adopted as set out elsewhere in this plan, and in the Environment Southland Factsheet on *Critical Source Areas,* and *Dairy NZ Wintering in Southland and South Otago Guide.*

E.4 Riparian Planting

The margins of McMillan Creek have been planted on the western side of the creek. The eastern bank, whilst fenced has not been planted as the creek is subject to regular 'cleaning' which is carried out by Environment Southland, which requires the bank to be free of vegetation which would restrict access to the creek. Accordingly, on the eastern banks of the creek, a grass buffer strip is maintained.

No further riparian planting is able to be undertaken.

E.5 Drain Cleaning

Environment Southland undertake regular clearing of the primary waterway (McMillan Creek) through the property in accordance with Southland Regional Council Flood Control Management Bylaw 2010. During this process the digger operator will clear sediment and material and stockpile this on the banks of the stream. Any drain cleaning works facilitated by Environment Southland are expected to be undertaken in accordance with *Drainage and Channel Maintenance Fact Sheet.*

F: Nutrient Budgeting

F.1 Soil Sampling

Nutrient management is a key component to ensuring good on farm environmental practice. The farm will operate under industry best practice guidelines and in accordance with the Nutrient Budget and Nutrient Management Plan, attached as Appendix E. The Nutrient Management Plan and Budget will be reviewed and updated as required, but on not less than an annual basis. The nutrient budgets have been prepared by a Certified Nutrient Management Advisor. The nutrient budget has been prepared using OVERSEER® 6.2.2 which is the latest version of the model. A copy of Overseer® budget and Nutrient Management Plan are attached as Appendix E.

Regular soil tests will be undertaken to establish the nutrient status of the soils. Soils should be at nutrient levels which avoid any adverse effects on the environment but maintain good pasture production and animal health, by ensuring that the soils are suitable for optimal plant nutrient uptake.

A representative whole fam soil sample at a block level will be undertaken at least once during any 12 month period.

Areas which are receiving FDE will be carefully managed to ensure nitrogen loadings are at acceptable levels and are compliant with conditions imposed by resource consents. The annual effluent nitrogen loading rate shall not exceed 150kg/N/ha. Effluent will be applied utilising low rate application. Effluent management is discussed in Section G of the FEMP.

Levels of potassium will also be monitored to ensure good animal health outcomes, particularly with respect to the effluent block. For more information regarding the nutrients associated with this property please refer to Appendix E of the FEMP for the Nutrient Budget which has been prepared by Miranda Hunter of Roslin Consulting Limited.

F.2 Nutrient Budgets

Assessing Nutrient Losses for consistency with Resource Consent

The resource consent for this dairy operation has been granted on the basis of Nitrogen losses being 29kg/ha/yr and Phosphorus losses of 0.7kg/ha/yr. To ensure that the effects of the dairy farm remain consistent with those proposed in the application the consent holder will periodically assess their actual farming system against the consented farm system in the resource consent.

For the purposes of this FEMP the following terms shall have the following meaning:

1. “Forthcoming Year” means the period from 1 August to 31 July.
2. “Overseer® Benchmark File” is the OVERSEER® input file defined as [?] and attached to and forming part of this Farm Environment Plan.
3. “Milking Season” means the period from 1 August to 30 May.

4. "Nitrogen Loss Calculation" means the amount of nitrogen lost annually from the property over the most recent four year period, including the forthcoming year. The four year period allows for variances in production, climate and farming operation to be taken into account.[3] And reflects the fact that OVERSEER® is a long term average model.

Nitrogen and Phosphorus losses from farm activities to be undertaken in the forthcoming year must be assessed against the farming activities described in the Overseer® Benchmark File.

Process for assessment

A. Using the Overseer® Benchmark File, a report shall be prepared not less than one month prior to the commencement of the Forthcoming Year calculating the losses of nitrogen and phosphorus under the latest version of Overseer®. These losses shall be the 'Nitrogen Discharge Allowance ("NDA") for the dairy farming operation under this FEMP.

B. A second report shall be prepared not less than one month prior to the commencement of the Forthcoming Year to determine the Nitrogen Loss Calculation under the latest version of the Overseer® model. This report will be used to ensure that the nitrogen loss calculation does not exceed the NDA.

If the process above indicates that the operation proposed for the Forthcoming Year will give rise to a Nitrogen Loss Calculation that exceeds the NDA, the consent holder will adjust the proposed farming system to ensure that the NDA is not exceeded. Records of the adjustments made to achieve this must be kept and provided to the Council upon request.

The process for assessment must be completed by a Certified Nutrient Management Advisor with the advanced certification.

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[3] Environment Canterbury, Overseer Information Sheet for Farmers, May 2015 www.ecan.govt.nz

Table 11: Good Nutrient Management Practices (currently undertaken and proposed to continue on Farm)

Mitigation	Mitigation Aims	Good Management Practice	Location
Nutrient Management	- Nutrient Management	Prepare a Nutrient Budget as required by Appendix N of the Proposed Southland Water and Land Plan.	Whole farm
		Use proof of placement for fertiliser and farm dairy effluent application.	
		Keep soil Olsen P levels at agronomic optimum; test soils regularly (annually) to check.	Whole farm
		Apply fertiliser up to the edge of the paddock where riparian planting is present and provide a 10m set back from the bed of creeks when applying fertiliser and there is no riparian planting.	Whole farm
		Annual Soil Testing Program	Whole farm

G: Farm Dairy Effluent Management

As at the date of this plan [11 January 2017] the property has not been converted, accordingly there is currently no FDE system operated on the property. The details given below are based on what is proposed to be established as part of the conversion of the property. This plan will be updated at the time of conversion (or as part of any review of the FEMP) to reflect the actual details of the FDE System.

The Farm Dairy Effluent (FDE) section of this plan documents the methods that will be employed in the operation of the FDE System so as to ensure that the discharge of effluent occurs in accordance with anticipated conditions of the consent.

The following reference document will be utilised in the operation of the FDE System "*Dairy NZ Staff Guide to Operating Your Effluent Irrigation System – Low Rate System*". A full list of reference documents is set out in Section K FEMP.

G.1 Effluent System Overview

Total Effluent Disposal Area (ha)	93 ha	Available Storage Volume:	930 Cubic Metres	Maximum Daily Application Depth:	20 mm/daily application
High Risk Soils (ha)	93 ha	Storage Type:	Above Ground Tank	Maximum Pulsed Depth Rate:	10mm/hour
Low Risk Soils (ha	-	Application System:	Larral Smart Hydrant		

G.2 FDE Good Management Practices

All practicable steps will be taken to reduce FDE generation on the property. The following general guidelines as outlined by Dairy NZ will be adopted;

- Minimise water use – the applicant will utilise a green wash system.
- Clean stone trap regularly.
- Maintain and Service all parts of the effluent system.
- Ensure application conditions are acceptable prior to beginning application.

By reducing the amount of effluent and sludge at the source, i.e. the dairy shed; it can be expected that less effluent will require disposal in the long run. Effluent can be minimised as follows;

- Treat the herd gently to avoid upset.

- Reduction of cow stress levels by being quiet and even tempered.
- Reduction of the potential for loud and or unusual noises.
- Reduction of situations cows are not accustomed to.
- Keep use of hoses to a minimum and ensure efficient use of water.
- Repair leaks immediately and maintain storm water drains.
- Recycle water where possible.

G.3 FDE Operational Guide

Prior to the operation of the effluent system, the following steps shall be undertaken;

- Check weather forecasts and avoiding application during or immediately prior to predicted high intensity rainfall events
- Check and record soil moisture levels. Effluent **MUST NOT** be discharged when the soil is at field capacity. Soil Moisture will be tested on farm (via hand held meter) prior to each application of effluent.
- Check wind conditions to ensure that effluent can be discharged without resulting in spray drift and odour beyond the boundary of the property
- Set timer clock on the effluent pump for required duration i.e. One hour
- Check that the effluent pump has come up to optimum operating pressure
- Check all of the nozzles are unblocked
- Check the effluent line for any leaks
- During operation perform regular checks to ensure that the discharge is not resulting in ponding or surface run-off. If surface ponding is occurring, switch the effluent system off, and re-check soil moisture levels
- Record details of the effluent disposal duration, volume and location and keep records for future reference (record these details on the form attached as Appendix D).

G.4 FDE System Monitoring

Following the installation of the FDE system, the system shall be certified by a suitably qualified person that it has been designed and constructed in accordance with the "*Environment Southland Code of Practice for Design and Construction of Agricultural Effluent Ponds, March 2009".*

Within one month of the installation of the FDE system, the application rate of the system will be assessed utilising the *Bucket Method* as set out in the "*Dairy NZ Staff Guide to Operating Your Effluent Irrigation System – Low Rate System"* and records of the assessment kept.

Application Rates shall be assessed annually thereafter in accordance with the methodology specified in *Dairy NZ Staff Guide to Operating Your Effluent Irrigation System – Low Rate System.*

G.5 FDE System Maintenance

Maintenance of the effluent system is essential to ensure that the system is working as intended. Monthly maintenance checks will be undertaken to ensure that all parts involved in the catchment, storage and disposal of effluent are functioning correctly.

The following checks will be undertaken on a regular basis and details recorded:

- Clean stone traps (monthly);
- Check the sump is clear of solid material. If necessary, arrange to clean out the sump;
- Regularly clear the tank of solids when required (expected to be once every two years);
- Check nozzles are clear and in good working order; and
- Check effluent pipe is in good working order and does not have any leaks.

Any matters requiring follow up shall be followed up immediately. A monthly check sheet template is attached as Appendix D.

G.6 FDE System Training

The efficient operation of the effluent system in accordance with the conditions of consent requires staff to be sufficiently trained in the use and operation of the effluent system, including an awareness of the conditions of the consent which control the discharge of effluent.

The Farm Owner will be responsible for ensuring that all staff are trained in the operation and maintenance of the effluent discharge system, and for training new employees. A guide to staff training requirements is detailed in Appendix D, and shall be completed once training has been provided. Effluent training should be revisited or recapped at the beginning of each season to ensure all staff, new and existing, are aware of consent requirements and responsibilities.

Opportunities for further training to improve effluent management will also be identified and undertaken as appropriate, including encouraging attendance at Dairy NZ Effluent Management Workshops/Training and fieldays or similar industry recognised training.

H: Monitoring Programme

Water quality monitoring shall be undertaken to provide an indicative assessment of loss of nutrients to surface water from the property. The purpose of this monitoring is to enable an assessment of the effectiveness of on-farm management practices to ensure that the farm is operated in accordance with the conditions of consent, and in a manner which does not increase the discharge of nutrients (particularly nitrogen and phosphorus). The monitoring program documents methods for monitoring nutrient loads to surface water H.1 to H.6) and methods for monitoring nitrate leaching to shallow groundwater (H.7 to H.12).

As at the date of this plan [27 July 2016] the property has not been converted. The monitoring program as set out below is intended to be implemented in conjunction with the conversion of the land. Where there is a delay in the completion of the conversion, it is intended that a series of baseline water quality sampling will be undertaken such that reflects current landuse providing a benchmark value. These baseline values will be collected in accordance with the parameters set out in H.1 to H.6 below.

H.1 When to Monitor Surface Water

This section sets out the optimum time that samples should be collected. Monitoring data show that the highest N and P concentrations and loads occur under the highest flows. The primary contaminant pathways on the property have been identified as being overland flow and via artificial drains. Therefore, **monitoring shall occur** during high flows, which are defined as periods when;

Soil moisture is at or above 75% of field capacity and there is (or is predicted) more than 10 mm of rainfall over a 24-hour period; or, When flow in the Waituna Creek at Marshall Road is above 5,000 litres per second (mean annual flood level)[4].

Under these conditions, it is likely that overland flow and mole-pipe drain discharge will be occurring. It is noted that soil moisture is typically highest between April and October so this is the period when sampling is most likely to occur.

It is noted by Diffuse Sources and NIWA (2012) that other activities, such as drain clearing, are likely to be major contributors to nutrient and sediment loads to the Waituna Lagoon. The consent holder will document when drain clearing occurs (it is noted that drain clearing on the property is undertaken by Environment Southland).

H.2 Frequency of Monitoring of Surface Water

Monitoring shall take place at least twice over any 12-month period. Monitoring shall also be taken under the current land use in order to establish a benchmark.

H.3 What to Monitor for Surface Water

All water quality monitoring should include the following as a basic site description:

- Site name
- Date

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[4] This is Diffuse Sources and NIWA's (2012) definition of a "storm event" at this site

- Time (to the nearest minute, and specify whether in NZST (standard time) or NZDT (daylight savings))
- Weather observations e.g. is it raining, overcast, fine, windy
- Sample water observations e.g. is it clear/turbid, what colour
- Land use on the property in the catchment area being sampled e.g. recent effluent/fertiliser application, no stock, crop type
- It is good practice to take a photo of the water being sampled, and general surrounds. This is particularly useful should there be some anomalous lab results or to document other activities (such as drain clearing) which might affect results.

Tile drain discharge

Flow: time (to the nearest second) how long it takes to fill a container of a known volume. For example, if it takes 20 seconds to fill a 10 litre bucket, the flow is 0.5 litres per second (i.e. volume divided by time). This should be repeated at least twice in order to obtain an average flow for each tile drain sampled.

Water quality parameters (as recommended by Diffuse Sources and NIWA (2012) for characterising nutrient and sediment loads to the Waituna Lagoon):

- Total suspended solids (TSS)
- Nitrate + Nitrite – Nitrogen (NNN)
- Total ammoniacal nitrogen (TAN)
- Dissolved organic nitrogen (DON)
- Total nitrogen (TN)
- Dissolved reactive phosphorus (DRP)
- Total dissolved phosphorus (TDP)
- Total phosphorus (TP)
- *E.coli*

- Electrical conductivity (EC)

Note: TDP and DON allow characterisation of the proportion of particulate versus dissolved/colloidal nutrients and it is not possible to estimate particulate or total dissolved nutrient loads without these parameters.

H.4 Who Shall Monitor Surface Water

Monitoring shall be carried out by a suitability qualified expert or an individual who has been trained by a suitably qualified expert (note: the training does not need to occur under the sampling conditions described above).

If the sampling is to be undertaken by an individual who was been trained by a suitably qualified expert, the expert shall provide documentation of the training to demonstrate competency. Monitoring could also be subject to independent auditing (i.e. by Environment Southland) on an annual basis.

H.5 Where to Monitor Surface Water

Surface water monitoring shall be undertaken at tile drains which are discharging. At least one drain from Groups A, B and C (see map below) shall be monitored on each sampling occasion. The more discoloured discharge from the tile drains should be preferentially sampled as these represent the greatest likelihood of capturing the highest contaminant loss.

Tile Drain Discharge – Group B Location

Sampling to be taken at outfall as shown.

Figure 5: Surface Water Sampling Locations

H.7 When to Monitor Ground Water

Groundwater samples are best monitored in autumn and spring. Surplus nitrogen will accumulate in the soil over summer and early autumn, and will then be flushed through as soil drainage initiates in late autumn. The autumn sample should target this 'first flush' which can be determined from soil moisture and rainfall monitoring. The spring sample should better reflect average nitrate leaching that occurs during the drainage season (i.e. during winter and spring when soils are wet and tends to be when most drainage occurs).

H.8 Frequency of Monitoring of Ground Water

Groundwater monitoring shall be undertaken twice per year.

H.9 What to Monitor for Ground Water

All water quality monitoring should include the following as a basic site description, and records documenting this information shall be kept:

- Site name
- Date
- Time (to the nearest minute, and specify whether in NZST (standard time) or NZDT (daylight savings))
- Weather observations e.g. is it raining, overcast, fine, windy
- Sample water observations e.g. is it clear/turbid, what colour
- Land use around the bore e.g. recent effluent/fertiliser application, no stock, crop type
- It is good practice to take a photo of the bore being sampled, and general surrounds. This is particularly useful should there be some anomalous lab results.

Water quality parameters:

- Nitrate + Nitrite – Nitrogen (NNN)
- Total ammoniacal nitrogen (TAN)
- Dissolved reactive phosphorus (DRP)
- *E.coli*
- Electrical conductivity (EC)
- Chloride (Cl)
- Total iron (Fe)
- Total manganese (Mn)

Fe and Mn should be sampled for the first two sampling rounds to ensure groundwater is not oxygen-reducing. Nitrate tends to denitrify (i.e. convert to gas) in oxygen-reducing water. Therefore, if groundwater is reducing, it is unlikely that nitrate will accumulate to high levels.

H. 10 Who Shall Monitor Ground Water

Monitoring shall be carried out by a suitability qualified expert or an individual who has been trained by a suitably qualified expert (note: the training does not need to occur under the sampling conditions described above).

If the sampling is to be undertaken by an individual who was been trained by a suitably qualified expert, the expert shall provide documentation of the training to demonstrate competency. Monitoring could also be subject to independent auditing (i.e. by Environment Southland) on an annual basis.

H.11 Where to Monitor Ground Water

Groundwater shall be monitored from a shallow groundwater monitoring bore which shall only be used for monitoring purposes. The site of the groundwater monitoring bore shall be agree in writing with Environment Southland's Compliance Manager. Where agreed by Environment Southland an existing bore on the property may be utilised for monitoring purposes, or a new bore shall be located within one of the general areas marked below (in blue).

Figure 6: Groundwater Monitoring Location Plan

H.12 Response to Monitoring of Ground Water

The monitoring results will be incorporated in the annual review of the FEMP. If, over the course of 2 years, nitrate concentrations increase by more than 0.5 mg/L, then a suitably qualified nutrient management advisor should undertake a review of N management. A suitability qualified expert shall also review the frequency of monitoring if an increase is identified.

I: Compliance & Reporting

The conditions of resource consent (Appendix B) shall be complied with at all times. Sections I.1 and I.2 set out the records which are required to be kept which will enable the Consent Holder to demonstrate compliance, as well as detailing the reporting requirements of the consent(s). The Consent Holder will also participate in annual compliance monitoring inspection programs that are to be implemented by Environment Southland.

I.1 Records to be Kept

To demonstrate compliance with the conditions of consent, and to enable an auditable review of the FEMP the following records shall be kept and maintained by Schrader Mains Limited;

- Accurate and auditable records of annual farm inputs, outputs and management practices i.e. Fonterra Farm Diary
- Farm Risk Map
- Nutrient Budget
- Nutrient Management Plan
- Soil Sampling Results
- Water Quality Sampling Results & Records
- Water Abstraction Data Records

- Water Meter Certification
- Effluent Area Map
- Effluent Records i.e. Effluent Application Diary
- Soil Moisture Probe Readings
- Staff Training Records
- Farm Procedures Manual
- Application Depth Test Results
- Monthly Maintenance Check Sheets
- Fertiliser Application Records including rates
- Crop types, locations and yields
- LIC Herd Records (proof of herd composition/age and type of stock carried on property)
- Animal Transfer Cards (proof of transport of herd outside of catchment)

I.2 Reporting

Annual reporting requirements are set out in the conditions of resource consent and include;

- Prior to the first exercise of the Effluent Discharge Consent the Consent Holder shall notify Environment Southland of the operator of the effluent system;
- Prior to the expiry of the Bore Consent the Consent Holder shall provide details of the bore [as set out in Condition 4 Bore Consent] to Environment Southland;
- Within one month of the first exercise of the Water Permit the consent holder shall provide a copy of the installation certificate for the water meter and data logger.

- Upon completion of the construction of the effluent storage pond written confirmation from a suitably qualified person shall be provided to Environment Southland to certify the pond has been constructed in accordance with the appropriate code.
- The Effluent Management Plan Shall be reviewed annually and results of the review reported to Environment Southland by 31 July each year;
- The Farm Environmental Management Plan shall be reviewed annually and results of the review reported to Environment Southland by 31 July each year;
- The Consent Holder shall provide records from the datalogger by 31 July each year.

J: Annual Review & Audit of FEMP

The FEMP shall be reviewed by a suitably qualified person on an at least annual basis. The review shall include (but not be limited to) an assessment of;

Verification of compliance with conditions of consent

Details of the implementation of Good Management Practice and identification of any new Good Management Practices that would be appropriate to employ on the farm to manage risks identified in Section B FEMP.

Overseer® parameter inputs report to confirm that the activity is being carried out in accordance with conditions of consent, and nutrient losses remain consistent with those proposed at the time consent was sought

A property specific environmental risk assessment, including a description of the risks to water quality, which shall be prepared by a suitably qualified person and which identifies any farm specific environmental risks along with measures to mitigate the identified risks.

Review of the data obtained from the monitoring undertaken in accordance with FEMP and any changes made or to be made to farming practice as a consequence of that monitoring data.

A report detailing items above shall be submitted to the consent authority no later than the 31 July each year including an updated version of the FEMP if any amendments have been made.

K: Industry Guidelines

A complete list of the industry guidelines which have been referenced in the development of this FEMP are listed below. The Consent Holder is also referred to the following general sources for guidance in respect to the operation and management of their property.

- Environment Southland www.es.govt.nz
- Dairy NZ www.dairynz.co.nz
- Fonterra www.fonterra.com

Reference Documents/Guidelines;

Dairy NZ – A staff guide to operating your effluent irrigation system – Low Rate System

Dairy NZ – A farmer's guide to managing farm dairy effluent – A good practice guide for land application systems

Dairy NZ – Wintering in Southland and South Otago – A land management guide to good environmental practice

Dairy NZ – Land management on Canterbury Dairy Farms – Managing land to reduce sediment and phosphorous loss

Environment Southland Factsheet – Critical Source Areas

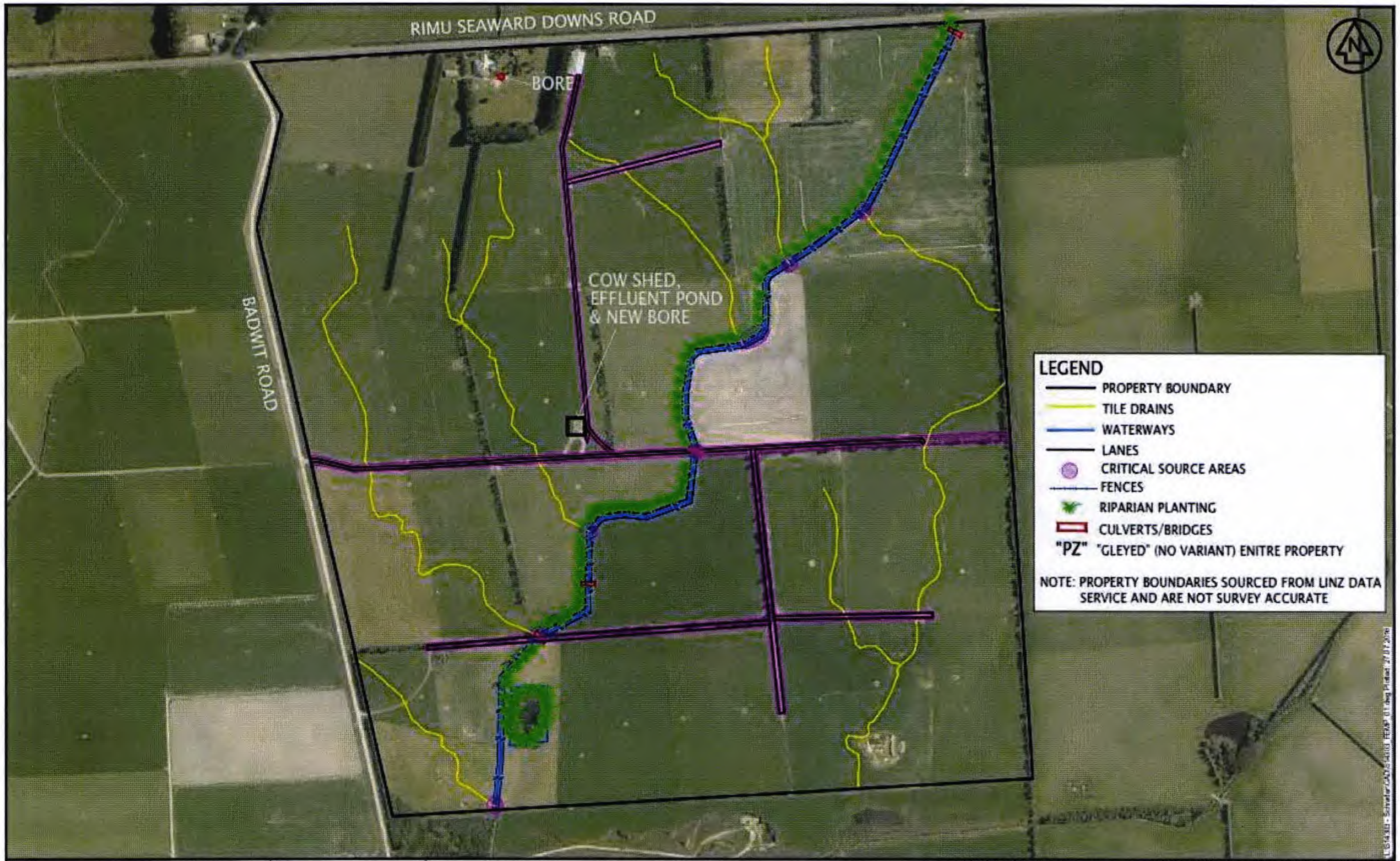
Environment Southland Factsheet – Drainage and Channel Maintenance

Environment Canterbury – Information Sheet for Farmers on OVERSEER®

Sustainable Dairying: Water Accord

APPENDIX A

FEMP SITE PLAN



LANDPRO

Client: SCHRADER MAINS LTD

NOTES

SCHRADER MAINS LTD
FEMP SITE PLAN

Rev.	Date	Revision Details	By
-	-	-	-

Surveyed | Signed | Date
Drawn: SLC | Signed | Date: 27.7.18
Designed | Signed | Date

Job No.: S14303
Drawing No.: 01
Scale: 1:2500 @ A1
1:5000 @ A3
Datum & Level: NZTM 2000
Rev.: -

LEGEND

▨	EFFLUENT DISPERSAL AREA (93.00Ha)
▬	PROPERTY BOUNDARY

Note. Buffers Zones of 20m apply to all Waterways and Boundaries
Buffer Zones of 100m apply to Water Bores and 200m from Residential Dwellings

L:\S14303 - Schrader\CAD\29.01.15 S14303_01_A_EF.dwg Plotted: 29.06.2015

LANDPRO
Make the most of your land

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Client
SCHRADER

NOTES
- All dimensions shown are in metres unless otherwise shown
- Copyright on this drawing is reserved
- Check any electronic data against the hardcopy plan to ensure it is the latest version
-If this plan is being used as part of sale and purchase agreement then it is done so on the basis that it is preliminary only, final dimensions and areas may vary on final survey

EFFLUENT DISPERSAL AREA
RIMU SEAWARD DOWNS ROAD, WAITUNA

Rev.	Date	Revision Details	By
-	-	-	-

Surveyed	Signed	Date	Job No.	Drawing No.
			S14303	01
Drawn	Signed	Date	Scale	
SLC		29.01.15	1:2500 @ A1 1:5000 @ A3	
Designed	Signed	Date	Datum & Level	Rev.
			NZTM 2000 & MSL	-

APPENDIX B

RESOURCE CONSENTS

APPENDIX C

INTENSIVE WINTER GRAZING AREA 2017/18

APPENDIX D

EFFLUENT SYSTEM RECORDS

Effluent Orientation and Training Record

Season___/___

Effluent Competencies	Employee name	Employee name	Employee name
General			
Understands the regional council rules and farm policies for effluent management			
Understands health and safety around the effluent system			
Understands record keeping for irrigator runs and maintenance			
At the Dairy			
Use of stormwater diversion system			
Good hosing practice and water management			
Animal handling to minimise effluent volume			
leaning the stone trap			
Sump, pump & pond monitoring and management (including float switches)			
In the Paddock			
When to irrigate: assessing soil and weather conditions			
Where to irrigate: runs, paddock rotations, high risk vs low risk soils etc (mark on farm map)			
Where not to irrigate: near waterways, drains, boundaries, slopes etc (mark on farm map)			
How the irrigator works, how to use it, set up, hose layout and performance checks			
Measuring the depth of effluent application			
Irrigator, pump maintenance/cleaning			
Greasing and general maintenance requirements (how and when)			
How to check and replace rubber nozzles and seals (same time as dairy rubber ware)			
Tyre pressure and condition			
Pipe-work, hose and hydrant condition			
Wire-rope, cam and ratchet condition			
Other			

Trainer signature			
Employee signature			
Date			

Date when staff become competent in each skill. If all training provided in one day, tick and date at the bottom.

DairyNZ

Irrigator run sheet

☑ Check the records to ensure effluent is due to be applied to that particular area

☑ Allow a minimum interval of 10 days between applications and grazing for animal health

☑ Ensure irrigator will be applying effluent to short pasture.

Date	*Paddock*	*Run*	*Name*	*Comments*

dairynz.co.nz

0800 4 DairyNZ (0800 4 324 7969)

You can use your Fonterra Dairy Diary as an alternative to this form, or photocopy a farm map – draw and date the runs on the copy then file it.

Schrader Mains Limited

Monthly Check Sheet

On a monthly basis the following checks and measures must be undertaken. The details of the monthly check shall be recorded on this sheet, and at the completion of the inspection the sheet shall be filed for future reference. If there are any matters requiring follow up work i.e. you note that an effluent nozzle needs replacing, please make a note of these, and ensure that the actions are followed up immediately.

Date:...

Employee:...

- ☐ Record volume of water abstraction ....

- ☐ Clean stone traps.

  Any further actions required? Y/N

  Explanation...

- ☐ Check all inlet and outlet pipes to storage ponds/sumps to ensure they are free of debris to prevent blockages.

  Any further actions required? Y/N

  Explanation...

- ☐ Check the stone trap is clear of solid material. If necessary arrange to clear out the sump.

  Any further actions required? Y/N

  Explanation...

- ☐ Check the level of solids, if necessary arrange for solids bed to be emptied when conditions are appropriate.

  Any further actions required? Y/N

  Explanation...

- ☐ Check effluent nozzles are clear and in good working order

  Any further actions required? Y/N

  Explanation...

- ☐ Check effluent irrigator pipe is in good working order and does not have any leaks

Any further actions required? Y/N

Explanation……

☐ Check well-head(s) remain capped.

Any further actions required? Y/N

Explanation……

APPENDIX E

NUTRIENT BUDGETS

Roslin Consultancy Ltd
ALEX HUNTER Agribusiness Consultants MIRANDA HUNTER

Schrader Conversion Proposal

Introduction

The property is located in the Waituna Catchment in Southland.

This property comprises of 109.52 ha in total. The property currently operates as a dairying grazing (young stock and cow wintering) and beef unit.

It is proposed that the property will be converted to dairying, with all young stock grazed off and all of the mature dairy cows will be wintered off.

Nutrient budgets have been constructed to estimate the nutrient loss from the existing operation (2015 / 16 season) and the proposed conversion (status quo).

Overseer Version

6.2.3

Information on Overseer can be obtained from the following reports

Technical Description of OVERSEER for Regional Councils, September 2015

Review of the phosphorus loss submodel in OVERSEER®, September 2016

Protocols

The nutrient budget has been developed using the "Overseer, Best Practice Data Input Standards, November 2016" – no deviations have been made from this protocol

Assumptions

To construct the nutrient budgets the following assumptions have been made;

Blocks

The farm has been split into the following blocks.

Block Name	**Soil Type**	**Smap Ref**	**Contour**	**Existing Operation (ha)**	**Proposed Conversion (ha)**
Pastoral Woodlands	Woodlands	Wood_29a.1	Flat	87.0	61.0
Effluent Woodlands	Woodlands	Wood_29a.1	Flat	0	26.0
Pastoral Dacre	Dacre	Paro_4a.1	Flat	16.0	16.0
Stock excluded				7.0	7.0
	Effective Farm Area			**103.0ha**	**103.0ha**
	Total Farm Area			**110.0ha**	**110.0ha**
Kale (rotating)				20.0ha	2.0 ha

- Soils on the property were assessed utilising the topoclimate information and Overseer soil settings were obtained from SMap
- Predicted soil test values have been used for a status quo dairy farm

Climate Data

- Invercargill as the location setting
- The following climate information has been used from the Overseer climate station tool;
  - 1152mm of rainfall
  - 10.1 degrees Celsius mean annual temperature
  - Daily rainfall pattern setting of 731 to 1450mm, none to weak
  - Mean annual PET of 775mm (moderate variation)

Farm System

Description	**Existing Operation (15 / 16)**	**Proposed Conversion**
Milk solids production		123,600 kg ms • 1200 kg ms per ha • 404 kg ms per cow
Cows on farm		Breed FJX July 0 Aug 320 Sept 315 Oct 306 Nov 306 Dec 306 Jan 306 Feb 300 March 300 April 270 May 240 June 0 **Peak cows milked = 306**
Mature cows and R2 heifers wintered on farm	95 R2s May 265 June and July 90 August	0
Replacements on farm	270 weaners (Dec to April) 270 yearlings (May to Jan) 242 yearlings (Feb to April)	0
Beef animals	29 Bulls 10 Beef breeding cows	0
Area crop	20 ha kale (yield 12 t DM / ha) • Grazed by beef / dairy animals – June, July and August	2 ha kale (yield 12 t DM / ha) • Grazed by cows August & September
Supplements	Imported • 47t DM baleage (fed on kale)	Imported • 225t DM baleage (fed across pastoral blocks)
Nitrogen	159 kg N per ha across all pastoral areas	152 kg N per ha on non effluent blocks, split applications Aug to March 101 kg N per ha on effluent block, split applications Sept to Feb
Farm dairy effluent	n/a	Holding pond Solids not separated Applied to 26 ha (low application)*
Overseer - predicted pasture grown	15.0 t DM / ha / year	15.1 t DM / ha / year

*Effluent area of 26 ha has been assumed in modelling, the area may be larger than this and reduce the nutrient loading accordingly. The N loading from effluent on the 26 ha is 93 kg / ha / yr.

Predicted Overseer Results –

	Existing Operation 15/16	Proposed Conversion
Total Farm N Loss	4338 kg N	2803 kg N
N Loss/ha	40 kg N / ha / year	25 kg N / ha / year
N Concentration in Drainage	Pastoral – 5.2 to 6.3 ppm Fodder crops – 18.8 ppm	Pastoral – 4.0 to 5.7 ppm Fodder crop – 20.9 ppm
Total Farm P Loss	47 kg P	78 kg P
Average P loss/ha	0.4 kg P /ha/yr	0.7 kg P /ha/yr

Miranda Hunter, Roslin Consultancy Limited

Bachelor of Agricultural Science

CNMA

5th December 2016

Miranda Hunter
Roslin Consultancy

Client reference:
Farm name: Schrader - Conversion Proposal - v6.2.3 - FINAL (Status Quo)

FarmParameters

OVERSEER

Farm details

Type	Farm type	Full range
Assessment	Assessment year	Status Quo
Region	Region	Invercargill

Farm blocks

Pastoral - Woodlands	Pastoral	61
Pastoral - Dacre	Pastoral	16
Effluent - Woodlands	Pastoral	26
Kale	Fodder Crop	
Non productive	Trees and Scrub	7
Total farm area declared in blocks	ha	110
Total farm area	ha	110
Non-productive area	ha	0

Farm animals

Stock numbers

Stock reconciliation - Dairy

Production

Milk solids	kg/yr	123600
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

Median calving date	24 August
Drying off	20 May
Percent of herd	0

Stock numbers

Class	*Breed*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*
MilkingHerd	F x J cross	0	230	315	306	306	306	306	300	300	270	240	0

Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated
0	0	0	0	0			Female	

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 types on pastoral blocks is the same as the farm stock ratios

Farm dairy effluent management system

Effluent management method		Holding pond
Solid separation and disposal		False
Pond solids		
Pond solids management method		Spread on selected blocks
Pond emptied every	years	2
Liquid effluent		
Liquid management method		Spray regularly

Animal health supplements

Animal - Dairy
No animal supplementation has been entered

Animal - Dairy replacements
No animal supplementation has been entered

Left over feeding

No left over feeding specified

Stored supplements

No supplements from storage added to this farm

FarmParameters

OVERSEER

Imported supplements

Supplement information

Conservation type		Silage
Name		Baleage
Supplement amount		
Dry weight basis	T	225

Supplements are distributed evenly across all pastoral blocks
No timing of feeding has been specified

Report settings

Greenhouse gas emission report units: Use default
Target N application rate as effluent: kg N/ha/yr

Block Information

Block - Pastoral - Woodlands

Block name		Pastoral - Woodlands
Block type		Pastoral
Area	ha	61
Relative productivity		1
Pasture block type		Yes
Topography		Flat
Distance from coast	km	18
Cultivated in last 5 years		False
Fodder rotates through		Yes

Climate

Annual average rainfall	mm/yr	1152
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm, None to weak
Annual potential evapotranspiration	mm	775
Seasonal variation in PET		Moderate

Soil description

Soil order (default)		Brown
Soil group (default)		Sedimentary
SMaps		
Sibling		Wood_291.1
Date downloaded		Unknown
Wilting point	0 - 30cm	21
	30 - 60cm	24
	> 60	24
Field capacity	0 - 30cm	41
	30 - 60cm	39
	> 60	41
Saturation	0 - 30cm	57
	30 - 60cm	50
	> 60	47
Natural drainage class		Imperfect
Depth to impeded layer	cm	Not entered
Maximum rooting depth	cm	Not entered
Top soil horizon chemical and physical parameters		
ASC/PR	%	43
Bulk density	kg/m^3	1090
Clay	%	28
Sand	%	13
Sub soil		
Sub soil clay	%	29

Soil profile

Profile drainage class		Imperfect
Top soil texture		Unknown
Maximum rooting depth	m	0

FarmParameters

Depth to impeded drainage layer		0

Soil drainage

Drainage method		
Method		Mole/tile system
Percent of paddock drained		40
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False

Soil settings

K leaching (%s)	Medium
N immobilisation status	

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30	7	8	10	8

QT SO4	10
Anion storage capacity or phosphate retention	Not entered
TBK reserve K test	Not entered
K reserve status	Use default

Pasture

Pasture type	Ryegrass/white clover
Clover levels	Use default

Supplements removed

No supplements removed from this block

Fertiliser application

Fertiliser products - December		
Category		Ballance super
Product		Superten
Amount	kg/ha	225
Fertiliser products - September		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - October		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - March		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - January		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - August		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - February		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55

Irrigation

No irrigation entered

Animals on block

Ratio and type of stock based on whole farm values due to this option being selected on block set up

Animals grazing		
Dairy	%	0

FarmParameters

Water connectivity		
Direct access to streams		False
Animal grazing		
January		True
February		True
March		True
April		True
May		True
August		True
September		True
October		True
November		True
December		True
Effluent application		
Solid effluents		
Effluent type added	December	Pond solids/sludge
Block - Pastoral - Dacre		
Block name		Pastoral - Dacre
Block type		Pastoral
Area	ha	16
Relative productivity		1
Pasture block type		Yes
Topography		Flat
Distance from coast	km	18
Cultivated in last 5 years		False
Fodder rotates through		Yes
Climate		
Annual average rainfall	mm/yr	1152
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm, None to weak
Annual potential evapotranspiration	mm	775
Seasonal variation in PET		Moderate
Soil description		
Soil order (default)		Gley
Soil group (default)		Sedimentary
SMaps		
Sibling		Paro_4a.1
Date downloaded		Unknown
Wilting point	0 - 30cm	14
	30 - 60cm	16
	> 60	17
Field capacity	0 - 30cm	47
	30 - 60cm	43
	> 60	46
Saturation	0 - 30cm	63
	30 - 60cm	52
	> 60	53
Natural drainage class		Poor
Depth to impeded layer	cm	Not entered
Maximum rooting depth	cm	Not entered
Top soil horizon chemical and physical parameters		
ASC/PR	%	35
Bulk density	kg/m³	940
Clay	%	25
Sand	%	9
Sub soil		
Sub soil clay	%	26
Soil profile		
Profile drainage class		Poor
Top soil texture		Unknown

FarmParameters

Maximum rooting depth	m	0
Depth to impeded drainage layer		0

Soil drainage

Drainage method	
Method	Mole/tile system
Percent of paddock drained	60
Hydrophobic condition	Use default
Occurence of pugging damage	Occasional
Compacted top soil	False

Soil settings

K leaching (%s)	Medium
N immobilisation status	

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30	7	8	10	8

QT SO4	10
Anion storage capacity or phosphate retention	Not entered
TBK reserve K test	Not entered
K reserve status	Use default

Pasture

Pasture type	Ryegrass/white clover
Clover levels	Use default

Supplements removed

No supplements removed from this block

Fertiliser application

Fertiliser products - December		
Category		Ballance super
Product		Superten
Amount	kg/ha	225
Fertiliser products - September		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - October		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - March		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - January		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - February		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - August		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55

Irrigation

No irrigation entered

Animals on block

Ratio and type of stock based on whole farm values due to this option being selected on block set up

Animals grazing

FarmParameters

Dairy	%	0
Water connectivity		
Direct access to streams		False
Animal grazing		
January		True
February		True
March		True
April		True
May		True
August		True
September		True
October		True
November		True
December		True

Effluent application

Receives no liquid or solid effluents

Block - Effluent - Woodlands

Block name		Effluent - Woodlands
Block type		Pastoral
Area	ha	26
Relative productivity		1
Pasture block type		Yes
Topography		Flat
Distance from coast	km	18
Cultivated in last 5 years		False
Fodder rotates through		Yes

Climate

Annual average rainfall	mm/yr	1152
Mean annual temperature		10.1
Seasonal variation in rainfall		731-1450 mm, None to weak
Annual potential evapotranspiration	mm	775
Seasonal variation in PET		Moderate

Soil description

Soil order (default)		Brown
Soil group (default)		Sedimentary
SMaps		
Sibling		Wood_29a.1
Date downloaded		Unknown
Wilting point	0 - 30cm	21
	30 - 60cm	24
	> 60	24
Field capacity	0 - 30cm	41
	30 - 60cm	39
	> 60	41
Saturation	0 - 30cm	57
	30 - 60cm	50
	> 60	47
Natural drainage class		Imperfect
Depth to impeded layer	cm	Not entered
Maximum rooting depth	cm	Not entered
Top soil horizon chemical and physical parameters		
ASC/PR	%	43
Bulk density	kg/m^3	1090
Clay	%	28
Sand	%	13
Sub soil		
Sub soil clay	%	29

Soil profile

Profile drainage class		Imperfect
Top soil texture		Unknown

FarmParameters

Maximum rooting depth	m	0
Depth to impeded drainage layer		0

Soil drainage

Drainage method		
Method		Mole/tile system
Percent of paddock drained		40
Hydrophobic condition		Use default
Occurence of pugging damage		Occasional
Compacted top soil		False

Soil settings

K leaching (%s)		Medium
N immobilisation status		

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
30	7	8	10	8

QT SO4		10
Anion storage capacity or phosphate retention		Not entered
TBK reserve K test		Not entered
K reserve status		Use default

Pasture

Pasture type		Ryegrass/white clover
Clover levels		Use default

Supplements removed

No supplements removed from this block

Fertiliser application

Fertiliser products - February		
Category		Ballance super
Product		Superten
Amount	kg/ha	175
Fertiliser products - September		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - October		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - January		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55
Fertiliser products - February		
Category		Ballance other
Product		N-rich urea
Amount	kg/ha	55

Irrigation

No irrigation entered

Animals on block

Ratio and type of stock based on whole farm values due to this option being selected on block set up

Animals grazing		
Dairy	%	0
Water connectivity		
Direct access to streams		False
Animal grazing		
January		True
February		True
March		True
April		True

FarmParameters

May		True
August		True
September		True
October		True
November		True
December		True
Effluent application		
Liquid effluents		
Receives farm dairy effluent		
Effluent application depth		Low application method
Percentage of block effluent applied to	%	100
Block - Kale		
Block name		Kale
Block type		Fodder Crop
Rotation area	ha	2
Low N mineralisation		False
Final grid month		November
Irrigation system type		No Irrigation
Crop information		
Current assessment year Status Quo		
December - Kale		
Crop management	See details below	Crop sown
Fertiliser or lime added	See details below	
January - Kale		
February - Kale		
Fertiliser or lime added	See details below	
March - Kale		
April - Kale		
May - Kale		
June - Kale		
July - Kale		
August - Kale		
Crop management	See details below	Defoliation
September - Kale		
Crop management	See details below	Defoliation
October - Bare ground		
November - Grazed		
Crop management	See details below	Crop sown
Crop sowing information - December of the Current assessment year Status Quo		
Crop category		Fodder
Crop type		Kale
Product yield	T/ha dry matter	12
Cultivation practice at sowing		Conventional
Defoliation information - August of the Current assessment year Status Quo		
Defoliation method		Grazed in-situ
Final harvest		False
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Dairy	%	100
Crop grazed for	hours/day	16
Defoliation information - September of the Current assessment year Status Quo		
Defoliation method		Grazed in-situ
Final harvest		True
Source of animal		Farm stock - see Enterprise numbers panes
Percentage of crop eaten by animals		
Dairy	%	100
Crop grazed for	hours/day	16
Crop sowing information - November of the Current assessment year Status Quo		

FarmParameters

Crop category		Permanent pasture
Crop type		Grazed
Source of animals		Not entered

Fertiliser application

Fertiliser products - Current assessment - December (N Method: Incorporated)

Category		Ballance cropping
Product		Cropzeal brassica base
Amount	kg/ha	250

Fertiliser products - Current assessment - December (N Method: Incorporated)

Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100

Fertiliser products - Current assessment - February (N Method: Surface applied)

Category		Ballance other
Product		N-rich urea
Amount	kg/ha	100

Effluent application

Receives no liquid or solid effluents

Block - Non productive

Block name		Non productive
Block type		Trees and Scrub
Area	ha	7
Rainfall	mm/yr	1152
Distance from coast	km	18
Bush type		Native

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Version 6.2.3, on 2016-12-05 03:23:08

Miranda Hunter
Roslin Consultancy

Client reference:

Farm name: Schrader - Conversion Proposal - v6.2.3 - FINAL (Status Quo)

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added							
Fertiliser, lime & other	130	18	0	21	43	0	0
Rain/clover N fixation	114	0	3	6	4	8	44
Irrigation	0	0	0	0	0	0	0
Supplements imported	33	6	41	5	10	3	3
Nutrients removed							
As products	76	13	18	4	16	2	5
Exported effluent	0	0	0	0	0	0	0
As supplements	0	0	0	0	0	0	0
To atmospheric	95	0	0	0	0	0	0
To water	25	0.7	11	36	42	12	30
Change in internal pools							
Plant material	0	0	-2	1	0	0	0
Organic pool	76	11	-1	-10	-2	0	0
Inorganic mineral	0	4	-22	0	-2	-3	-3
Inorganic soil pool	3	-4	39	0	2	2	14

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Version 6.2.3, on 2016-12-05 03:23:47

Miranda Hunter
Roslin Consultancy

Client reference:

Farm name: Schrader - Conversion Proposal - v6.2.3 - FINAL (Status Quo)

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Pastoral - Woodlands ##	1445	24	5.5	183	158
Pastoral - Dacre ##	266	17	4.0	181	152
Kale	230	115	**20.9**	48	106
Non productive	21	3	N/A		
Effluent - Woodlands ##	648	25	5.7	223	194
Other farm sources	193				
Whole farm	2803	25			
Less N removed in wetlands	0				
Farm output	2803	25			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Has a fodder crop rotating though, results for pastoral block component only

Version 6.2.3, on 2016-12-05 03:24:01

Miranda Hunter
Roslin Consultancy

Client reference:

Farm name: Schrader - Conversion Proposal - v6.2.3 - FINAL (Status Quo)

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Pastoral - Woodlands ##	17	0.3	Low	Low	Low
Pastoral - Dacre ##	8	0.5	Low	Low	n/a
Kale	1	0.4	n/a	n/a	n/a
Non productive	1	0.1	n/a	n/a	n/a
Effluent - Woodlands ##	8	0.3	Low	Low	Low
Other farm sources	44				
Whole farm	78	0.7			

Has a fodder crop rotating though, results for pastoral block component only

Attachment D – Technical Assessment

TECHNICAL ASSESSMENT

Date: 7th December 2016 File Ref: S14303

To: Kate Scott, Managing Director

From: Karen Wilson, Senior Environmental Scientist

Subject: **Water quality assessment for Schrader Mains Ltd dairy conversion, Waituna.**

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1 Background

A resource consent application to convert 103 hectares (ha) of agricultural land to a dairy milking platform was lodged with Environment Southland 31st July 2015 by Landpro Ltd on behalf of Schrader Mains Ltd (APP-20158099). The application was declined by a hearings panel on the 7th March 2016 on the basis the potential for significant adverse effects were unacceptable, and that the applicant had not demonstrated that the adverse effects of the proposed activities would be adequately avoided or mitigated. An appeal was subsequently lodged with the Environment Court (ENV-2016-CHC-014).

On the 3rd June 2016, Environment Southland released their proposed Regional Water and Land Plan (pSWLP) which includes new objectives for freshwater resources in the Southland region along with new rules and polices for managing the effects of farming activities. A resource consent application is being prepared for the proposed dairy conversion under the pSWLP.

The purpose of this report is to assess the potential water quality effects of the proposed activities for the purposes of addressing information requirements for the applicants' resource consent application under the pSWLP. This report incorporates findings from scientific reports on the Waituna catchment which have been published since the Environment Court appeal was lodged.

The property is located at 514 Rimu-Seaward Downs Road, Waituna, as shown in Figure 1.

Figure 1: *Site map of the of the proposed milking platform (shaded) and key topographical features.*
[Source: Environment Southland's Beacon website, 03/10/2016]

2 Receiving environment

2.1 Soils

Between 1998 to 2001, Topoclimate South undertook soil mapping of much of the Southland region to a 1:50,000 scale. This soil survey identified two combinations of soil series on the property, as shown in Figure 1. More recently, this soil survey has been incorporated into a national soils database (S-map) which has established national standardisation of soil series names. The legend for Figure 2 shows the equivalent soil series between S-map and Topoclimate South. In general, the property consists of predominately Brown soils (New Zealand Soil Classification (NZSC) Order), while Gley soils are found along the stream margins, making up approximately 16% of the property area.

Legend

	Topoclimate South	S-Map (Landcare)
Brown	Woodlands, Mokotua, Waikiwi	Woodlands (50%), Mokotua (30%), Waikiwi (20%)
Light blue	Dacre, Woodlands, Titipua	Paroa (50%), Woodlands (30%), Waimairi (20%)

Figure 2: *Mapped soil types for the proposed site (shown in red outline). The Topoclimate South soil series is mapped identifying the dominant to less dominant soil series (labels in map). The equivalent soil series in S-map includes an estimation of the percentage area of each soil series within a mapped polygon.*
[Source: Environment Southland's Beacon website and Landcare *S-map* website, 03/10/2016]

Table 1 provides a summary of the key characteristics of all the soil series identified on the property, with the dominant soil types summarised below:

- **Woodlands soils**
  Woodlands soils are classified as Brown soils (NZSC Order) and are formed in deep loess derived from greywacke and schist rock. These soils are imperfectly drained and have a silt loam texture. They are high-producing soils which rarely suffer from drought. There is a subsoil horizon that is structureless with slightly firm or greater soil strength that may limit root penetration. This subsoil horizon has slow permeability that causes waterlogging during wet periods. As a result, these soils are often artificially drained (mole-pipe drainage systems).
- **Dacre soils**
  Dacre soils are classified as Gley soils (NZSC Order) and are formed in fine alluvium from rewashed loess. These soils are moderately deep to deep with a silty texture and are poorly drained due to a high groundwater table, and limited profile development associated with their young age. Due to their poor drainage, these soils are also typically artificially drained (mole-pipe drainage systems).

Table 1: *Summary of soil types on the property (using the Topoclimate South soil survey information). Note: PRAW is Plant Readily Available Water, ASC is Anion Storage Capacity (or P-retention).* [Source: Crops for Southland, 2002]

Soil Series	*NZSC Classification*	*Key characteristics*
Woodlands	Mottled Firm Brown; stoneless; silty	Profile drainage: imperfect PRAW: high Potential rooting depth: deep Rooting restriction: no major restriction ASC: moderate (30-60%) Leaching risk: slight Waterlogging risk: moderate
Mokotua	Mottled-acidic Orthic Brown; stoneless; silty	Profile drainage: imperfect PRAW: high Potential rooting depth: deep Rooting restriction: no major barrier ASC: moderate to high (45-70%) Leaching risk: slight Waterlogging risk: moderate
Waikiwi	Typic Firm Brown; stoneless; silty	Profile drainage: well PRAW: high Potential rooting depth: deep Rooting restriction: no major barrier ASC: moderate to high (40-60%) Leaching risk: moderate Waterlogging risk: slight
Dacre	Acidic Recent Gley; stoneless; silty	Profile drainage: poor PRAW: high Potential rooting depth: deep Rooting restriction: limited subsoil aeration during sustained wet periods ASC: moderate to low (25-50%) Leaching risk: slight Waterlogging risk: severe

Titipua	Peaty Orthic Gley; stoneless; clayey over silty	Profile drainage: poor PRAW: very high Potential rooting depth: deep Rooting restriction: limited subsoil aeration during sustained wet periods ASC: moderate (54-75%) Leaching risk: slight Waterlogging risk: severe

Rekker and Scott (2016) identify Waikiwi soils as being the only soil series within the Waituna catchment which are categorised as being well drained. *"This suggests that they more prone to nutrient loss though drainage, and are more likely to drain to groundwater than near-surface routing to tile drains. Accordingly, nitrate accumulation vulnerability in underlying shallow, oxic groundwater is largely associated with these soils in the Waituna catchment."* The influence of soil types on contaminant pathways and water quality is discussed further in Sections 4 and 5 of this report.

2.2 Physiographic zones

Environment Southland have produced a regional spatial framework that delineates the region into nine non-contiguous physiographic zones. Each zone represents distinct combinations of inherent landscape properties that result in similar influences over water quality outcomes (Hughes *et. al.*, 2016a). Within physiographic zones, variants have been used to identify areas where the relative importance of contaminant pathways varies temporally (Hughes *et. al*, 2016b). The physiographic zones have been incorporated into the pSWLP as a means of spatially differentiating land use risk and consenting requirements.

Figure 3 shows the proposed dairy milking platform encompasses the Gleyed physiographic zone, as mapped by Environment Southland. The Gleyed physiographic zone comprises predominantly flat to undulating land that occurs between major river systems where soils are fine textured and poorly drained. This zone is characterised by soils which have distinctive redoxomphoric features such as mottling and gleying (resulting from extending periods of soil waterlogging). Soils in this zone have some ability to remove nitrogen from water to the atmosphere via denitrification, however this process can be bypassed when contaminants are flushed to nearby surface water bodies via artificial drains and overland flow following heavy or sustained rainfall events (Environment Southland, 2016a). No variants have been identified for the property which means artificial drainage is the sole dominant contaminant pathway.

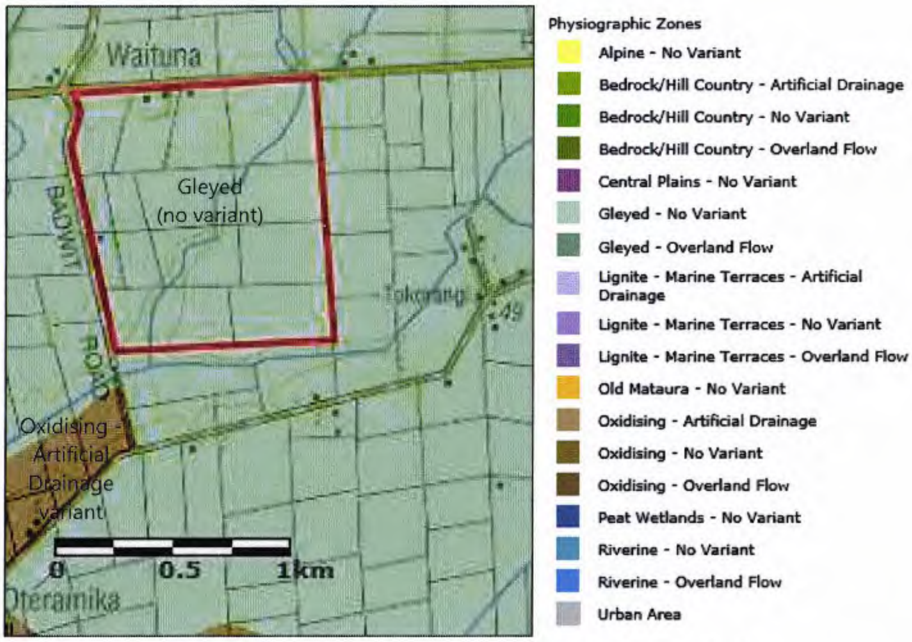

Figure 3: *Physiographic zones for the proposed site (boundary shown in red outline).*
[Source: Environment Southland's Beacon website, 03/10/2016]

2.3 Receiving water bodies

The farm is located in the upper Waituna Creek catchment area, approximately 20 kilometres (km) east of Invercargill. There is one stream running through the property that is locally referred to as McMillan Creek (shown in Figure 4). Within the property, at least six tile/novaflow drains have outlets into this creek. McMillan Creek drains into the Waituna Creek approximately 150 metres downstream of the property boundary with Waituna Creek discharging into the Waituna Lagoon along its north-western boundary. The Waituna Lagoon also drains the Moffat Creek and Carran Creek catchments, along with several smaller un-named streams.

The property is underlain by a groundwater resource that is part of the Awarua groundwater management zone (as delineated in the pSWLP). It is noted that this area was previously mapped as the Waihopai groundwater management zone in the Regional Water Plan for Southland 2010 (RWPS). Based on piezometric surveying results (Rissmann *et. al.,* 2012), groundwater in the area is assumed to predominately discharge into the Waituna Creek with some minor discharge possible directly into the lagoon and off-shore.

Figure 4: *Stream network surrounding the proposed site (property boundary shown in red outline).*
[Source image: Environment Southland's Beacon website, 05/10/2016. Photo insert: McMillan Creek looking upstream of the bridge, Landpro Ltd, 29/06/2015]

3 Water quality values and objectives

The RWPS and the Regional Coastal Plan for Southland, 2013 (henceforth referred to as the Regional Coastal Plan) describe the values and objectives for freshwater and coastal water bodies in the Southland region, respectively. These values establish the desired condition of the receiving environments and underpin the water quality standards used to assess the impact of land use activities.

Under the operative RWPS, surface water bodies on the property are classified as lowland hard bed streams. Table 2 summarises the values associated with these water body types as specified in the RWPS. The pSWLP does not use a classification system to establish values for rivers and streams however the regional objectives and values in the pSWLP are also provided in Table 2.

Table 2: *Summary of regional plans surface water values for streams in the property area*

Regional Plan	*Classification*	*Values specified in the Regional Water Plan*
Regional Water Plan for Southland, 2010 **Objective 3**	Lowland soft bed	- Bathing in those sites where bathing is popular; - Trout where present, otherwise native fish; - Stock drinking water; - Ngāi Tahu cultural values, including mahinga kai; - Natural character including aesthetics.
Proposed Southland Water and Land Plan, 2016 **Objectives 3, 6, 7, 9, 11**		- The mauri (inherent health) of waterbodies provide for te hauora o te tangta (health of the people), te hauora o te taiao (health of the environment) and te hauora o te wai (health of the waterbody) - There is no reduction in the quality of freshwater and water in estuaries and coastal lagoons - Avoid and reduce over-allocation (quality and quantity) of freshwater

		- 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 wellbeing. - Water is allocated and used efficiently

The RWPS establishes only one groundwater quality objective (Objective 8) that essentially states all groundwater quality must be maintained or enhanced to potable standards except for those aquifers where ambient water quality is naturally less than the Drinking Water Standards for New Zealand (DWSNZ). It is noted that Section 3.2 in the RWPS includes a Groundwater Outcome that specifies groundwater discharge should not have any adverse effect on surface water quality, aquatic life or recreational values however this does not appear to follow through to any Objectives, Policies or Rules. In the pSWLP Objective 8 states that the quality of groundwater must meet both the DWSNZ and any objectives for connected surface waterbodies, established under the Freshwater Management Unit process. The pSWLP also includes an objective (Objective 12) that requires groundwater levels maintain minimum surface water flows.

In 2010 a National Policy Statement for Freshwater Management[1] (NPSFM) was introduced requiring all regional councils and unitary authorities to establish freshwater quality and quantity objectives and to set 'limits' to achieve these. The NPSFM was revised in 2014 and specifically directs councils to safeguard fresh water's life supporting capacity, ecosystem processes and indigenous species and to prevent adverse effects on human health. It also sets a deadline for full implementation of the NPSFM by 2025. Environment Southland have released a schedule for rolling out freshwater limits in the Southland region and it is understood that the Waituna catchment limit setting process will occur in conjunction with the Mataura catchment in 2017-2019[2]. Although the NPSFM does not apply to coastal waters, the NPSFM does require Councils to improve integrated management of freshwater and coastal environments. It is noted that the NPSFM is included in both the RWPS and the pSWLP.

Section 3.11 in the Regional Coastal Plan describes the key values for the New River Estuary. These have been reproduced in Table 3 and in summary, the key values relevant to this application are the exceptional bird and waterfowl habitat, recreational, shellfish gathering and heritage values which can be adversely affected by excessive levels of microbes, sediment and nutrients.

Table 3: *Regional Coastal Plan values for Tiwai Point to Fortrose, including Waituna Lagoon*

Value	Description
Areas containing significant values	The coastal strip adjacent to Fortrose Spit and extending one kilometre seaward from the mean high water mark springs, has been identified by the Department of Conservation as an area of conservation value (see ACSV 14-07 in Appendix 5).
Natural character and landscape values	The dominant landscape elements in this reach are the extensive shingle beaches, gravel bars, dunelands and their associated native vegetation, and the adjoining peat bogs, lagoons, estuaries, salt marshes and tidal flats, most of which are largely unmodified. The lack of modification results in the area having very high natural

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[1] Ministry for the Environment, 2014. *National Policy Statement for Freshwater Management 2014.* New Zealand Government, July 2014.

[2] http://es.govt.nz/environment/water-and-land-2020-and-beyond/

	character of a type not found elsewhere in the region (see Appendix 4, Landscape Unit 5). The combination of open coastal and estuarine water bodies separated by intact indigenous vegetation gives rise to a landscape which, while not picturesque in the usual sense, has its own desolate and remote beauty. This attracts people on a regular and ongoing basis, but perhaps not in the same numbers as elsewhere. Access can be a limiting factor.
Heritage and archaeological values	While the mainland is not renowned for its archaeological or heritage values, the coastal waters and Ruapuke Island are. In the early 1800s, there was a thriving Maori community on Ruapuke. It was also an early mission station and an important provisioning point for early whalers, sealers and traders as well as a significant provider to mainland Southland. A smaller Maori community was located near the Toetoes Estuary. There was also a pre-European adze factory and Tiwai Point. The Dog Island lighthouse is also significant as it is the tallest in New Zealand (36 metres) and was built in 1865. The wreck of the 'Waikouaiti' (1939) also lies off Dog Island.
Coastal landforms and associated processes	Tiwai peninsula, Waituna Lagoon and Fortrose Spit are all geologically recent landforms connected to changes in sea level and the Mataura River. Submarine lignite deposits found in Toetoes Bay are rated as being of regional geological significance because the illustrate sea level rise and tectonism since early Quaternary time. While the relief of the peninsulas, spits and barrier beaches along this reach is low, they have strong, yet soft, horizontal lines. The dune system on the Fortrose Spit has been identified as containing a diverse and natural community of dune species which is rated as nationally important. The interaction between the sea and inland waters Is evident by the natural closing of the Waituna Lagoon outlet and the instability of the bar at the mouth of the Toetoes Estuary. The nearshore and foreshore protect these landforms from the action of waves. Sediments, especially quartz gravels are derived from local sources. Past coastal monitoring has suggested a trend towards accretion but this is possibly not indicative of every location within this reach. Almost all of the beach contains deposits of gold and platinum.
Recreational and amenity values	To some extent the recreational values are limited by a lack of access to this reach. For some, the lack of easy access is a challenge largely overcome by the se of three for four wheel motorcycles, while others use rough tracks created on the shallow peats and pea gravels and the mean high water mark. Direct access to the coast is available at the east end of Waituna Lagoon, and for those with prior written permission from New Zealand Aluminium Smelter, access is available through the smelter grounds to the beach behind. The west end of this beach is relatively sheltered and marks the change from beach to rocky shore. The wild, wilderness character of the beach can be an attraction in itself. Trout fishing at the mouth of the Waituna Lagoon is very popular, the spot being renowned for very large sea-run trout. Generations of people are drawn year after year to the lagoon for trout fishing and gamebird hunting. Surfcasting from the beach is an occasional activity and scuba diving and snorkelling are undertaken around the rocks at the western end. Although the soft and sometimes steep gravels make the beach tiring to walk, it does attract people who seek to beachcomb or enjoy the wilderness experience. Further out to sea, recreational diving for paua, crayfish and to a lesser extent oysters and fishing are popular activities for people on pleasure boars launched at Bluff or Fortrose.
Marine mammals and birds	While right whales are occasionally observed from the shore and dolphins more frequently so, the area has no particular significance for marine mammals.

	Some birds, especially black-billed gulls, oyster catchers and banded dotterel, nest on the gravel platform at the top of the beach. The rocks east of Tiwai Point are a roosting area for Stewart Island shags.
Ecosystems, vegetation and fauna habitats	The vegetation on Tiwai Peninsula landward of the beach includes a small area of *Oleria nummularifolia* (coin-leafed daisy) which is normally a subalpine shrub, and the southern limits of other subalpine species such as the *Donatianovae sealandiae* (a cushion plant) matagouri and speargrass. The peninsula is regarded as a fine example of recovering vegetation subsequent to the cessation of burning, and grazing by domestic animals. There is also significant invertebrate fauna, especially moths, many of which are usually only found in subalpine areas. Further to the east, Waituna Wetlands Scientific Reserve adjoins the coastal marine area. This 10 kilometre long, 3,500 hectare reserve, has been designated as a Wetland of International Importance, the values of which are more particularly documented in the Oceania Wetland Inventory, a copy of which is available from the Department of Conservation. A three kilometre strip of coastal farmland separates the scientific reserve from the Fortrose Spit, which contains nationally significant dune communities. In this reach, while the foreshore and nearshore are not particularly significant in terms of vegetation and fauna, the land adjoining it is quite the opposite. The foreshore can tolerate considerable use so long as those activities do not adversely impact on adjoining land. The waters off Ruapuke and Green Islands are productive rock lobster and paua fisheries, commercial paua fishing being prohibited from within one nautical mile of their shoreline.
Commercial values	The seas of this coast are commercially important for crayfish, blue cod and paua, and is also important for dredge oysters. All of the foreshore (and some of the seabed) is subject other either mining or prospecting licenses for gold. Recent history has seen a few mining operations come and go but there are signs of continuing and renewed interest.
Navigational safety	Dog Island is owned by the Maritime Safety Authority who operates a lighthouse on the island. Another smaller light is located in this area on land at Bushy Point and together with lights at Waipapa and Slope Points further to the east, and a lighthouse at Centre Island west of Bluff, ships are guided through Foveaux Strait.
Principal issues	1. Lack of access to the area and consequent need to preserve access along the beaches. 2. Threat of activities in the coastal marine area adversely affecting the natural values of adjoining coastal environment.

3.1.1 Strategy and Action Plan for Waituna

In August 2015, Environment Southland published a *Strategy and Action Plan for Waituna* which describes the vision, goals and key actions for the catchment. This document describes 11 key action points which are in summary:

- Finding out what makes the Waituna catchment important to people (AgResearch, 2015);
- Cultural Opportunities Mapping Assessment and Response (COMAR) project (planned completion date April 2016);
- Research to increase knowledge about nutrient losses and new cost-effective technologies/techniques for minimising losses (ongoing);
- Investigate potential locations and benefits for retiring land within the catchment and/or around the lagoon (mapping and cost-benefit analysis to be completed by 30 September 2016);

- Minimise environmental risk of effluent storage/disposal through compliance with discharge consents and industry-led assessments, and implementation of good management practices (at all times);
- Managing riparian, winter grazing and drain maintenance activities according to good practice guidelines and prepare annual nutrient budgets for each farm including undertaking mitigation strategies to reduce nutrient loss (ongoing);
- Review the effectiveness of bank reconstruction work and undertake additional works where suitable to reduce sediment load to the lagoon, and implement a wider stream habitat management project to restore instream and riparian habitat at priority sites (current bank restablisation completed 30 June 2015 and undertake further works as funding becomes available);
- Investigate options for management of lagoon levels with an opening/closing regime and obtain a new consent for management of lagoon openings (peer-reviewed reports to be completed by 31 December 2015);
- Identify existing on-farm wetlands and provide guidelines and assistance with their protection and protect indigenous vegetation (ongoing);
- Raise awareness of the importance of mahinga kai, how it can be accessed and the implications for the Scientific Reserve status of the lagoon (communications strategy to be completed by 30 June 2016); and,
- Monitor the *Ruppia* population and investigate the risks for *Ruppia* reestablishment (peer-reviewed report to be completed by 30 March 2017).

It is unclear whether these reports (other than those referenced) have been completed within intended timeframes. It is noted that the Strategy and Action Plan for Waituna does not specify nutrient targets or catchment load limits.

4 Receiving environments sensitivity, susceptibility and existing water quality

4.1 Waituna Lagoon

The Waituna Lagoon is a relatively large, brackish, intermittently closed and open coastal lake and lagoon (ICOLL) that is located approximately 10 kilometres east of Invercargill. The lagoon is fed by three freshwater streams, the largest of which is the Waituna Creek, and drains to the sea through an artificially managed opening.

Historically, the lagoon was surrounded by a peat bog wetland about 20,000 ha in size whose drainage gave the lagoon water its characteristic clear brown humic stain, low nutrient status and low pH. It is considered to be one of the best remaining examples of a natural coastal lagoon in New Zealand and forms a unique, highly valued feature of the Southland environment (Thompson and Ryder, 2003). The lagoon and adjacent wetland area totalling 3,500 hectares was designated a Ramsar Wetland of International Importance in 1976. In 2008, this was extended to include the wider, 20,000 ha wetland complex referred to as the Awarua Wetlands. It is noted that the Waituna Lagoon is included as a Sensitive Waterbody in the pSWLP (Appendix Q). In addition to having international, national and regional significance, the cultural significance of the Waituna Lagoon to the Ngāi Tahu people has been recognised through a Statutory Acknowledgement in the Ngāi Tahu Claims Settlement Act 1998.

Historically, the Waituna Lagoon was surrounded by peat bog wetland, the drainage from which gave the lagoon its characteristic colour, low nutrient status and low pH. These features supported high ecological habitat diversity, a unique seagrass community (*Ruppia* dominated), internationally important birdlife and large areas of relatively unmodified wetland and terrestrial vegetation (Thompson and Ryder, 2000, Robertson *et al.*, 2011). In addition to its ecological importance, the lagoon is also valued for its aesthetic appeal, biodiversity, recreational and scientific significance (Robertson *et al.*, 2011).

Currently, the Waituna Lagoon sits at the bottom of a small coastal catchment whose land use is dominated by agriculture including intensive sheep and beef, dairying and dairy support. As part of land development, the catchment has undergone drainage of wetland areas and clearance of indigenous vegetation. The lagoon is periodically, artificially opened to prevent flooding of adjacent farm land and to improve catchment drainage. Following an opening, the lagoon sea-barrier reforms naturally (taking a period of days to more than twelve months).

In 2010, it was identified that monitoring data highlighted a rapid decline in the ecological condition of the lagoon to the point it had deteriorated from a high value seagrass (*Ruppia*) dominated state to a more degraded condition with nuisance epiphyte and algal blooms and sediment anoxia causing stress to the keystone *Ruppia* species (Hamill, 2011). Expert opinion at the time was that unless urgent intervention occurred, the lagoon could undergo a regime shift to an even more degraded phytoplankton dominated state which would change the fundamental values and character of the lagoon (Robertson *et al.*, 2011).

In response to the expert opinion, Environment Southland initiated a multi-agency and community response that incorporated a range of scientific investigations and catchment works along with changes to the opening regime and land management within the catchment. Although the nature of the response has changed over time, the response to water quality issues in the Waituna catchment are on-going (see Section 3.1.1).

The ecology and water quality in ICOLL's are driven by complex interactions between the opening regime, climate and catchment nutrient loads. In terms of management, there is a "trade-off" between the salinity and desiccation pressures on macrophytes from artificial opening events versus the potential for these events to flush nutrient-laden freshwater and organically-enriched sediments from the lagoon (Hamilton *et al.* 2012). Modelling results by the University of Waikato show that *"under current catchment nutrient loads it is not possible to maintain a "healthy" Ruppia population in the lagoon with changes to the opening regime alone"* (Hamilton *et al.*, 2012). However, the amount of nutrient load reductions required to sustain persistent and productive *Ruppia* beds are dependent on the opening regime adopted (Hamilton *et al.*, 2012).

The recommendations of the Waituna Lagoon Technical Group (2013), which were released by Environment Southland in 2015, proposed a number of targets aimed at maintaining a healthy macrophyte community and avoiding a regime shift in the Waituna Lagoon. In summary, these targets are:

- >30-60% cover of *Ruppia* and other indigenous macrophytes (based on average annual percent cover at permanently wetted sites);
- nutrient load limits of <125 tonnes/year for nitrogen (equivalent to a lagoon aerial loading of <90 kg N/ha/year) and <7.7 tonnes per year for phosphorus (a lagoon aerial loading of <5.7 kg P/ha/year); and,
- manage the lagoon opening regime so that:

- spring and summer time openings are avoided with a minimum water level of 2.0 metres for openings between May and June, and 1.8 metres for July openings;
- time openings with windy periods when resuspension and flushing effect will be highest;
- investigate the feasibility of manually closing the lagoon; and,
- Walker's Bay is used as the standard opening location (with experimental openings at Hansen's Bay to determine whether other locations could reduce to the threat to aquatic vegetation communities while extending flushing benefits to other parts of the lagoon).

It was estimated the load targets were approximately 50% of the current (as at 2013) nitrogen and phosphorus inputs to the lagoon. The recommended catchment loads are *"not intended as broad brush reductions across the whole catchment, or for all farm land in the catchment, but rather as reductions in the amount of nutrients reaching the lagoon"* (Waituna Lagoon Technical Group, 2013). It was also noted that the recommended lagoon opening regime represented a change from existing practice, and is intended to maintain at least a 'moderate' lagoon state i.e. predominately freshwater lagoon with a short marine phase (e.g. two months).

Water quality in the Waituna Lagoon fluctuates in accordance with the opening and closing regime. The last published information by Environment Southland on the state of water quality in the Waituna Lagoon was in June 2014 (Environment Southland, 2014). This document states that nutrient levels in the lagoon were relatively low over the spring and summer of 2013/14 in response to flushing from the tide (the lagoon was open to the sea during this period following a mechanical opening in July 2013). A spike in chlorophyll *a* was observed between August and September 2013 however this was considered to be minor in comparison to historic records and an increase in chlorophyll *a* is typical at that time of year as water temperatures rise and windy weather mixes nutrients throughout the water column leading to phytoplankton growth. In summary, the document notes that *"while the benefit of an open lagoon is that nutrient levels remain low, the downside is that the influx of salt water reduces Ruppia growth. Ruppia is a genus of aquatic plant found in Waituna Lagoon and* [is] *an indicator of lagoon health. It plays an important role in the uptake* [of] *nutrients from the water column and binding sediment with its roots"* (Environment Southland, 2014).

Environment Southland have indicated they are about to undertake a water quality update for the Waituna Lagoon, however this report is currently unavailable (K, Robertson *pers. coms.* 2016)[3]. Monitoring of macrophytes in the lagoon is undertaken by the Department of Conservation and the results from the 2015/16 summer show *"an average lagoon-wide total macrophyte cover of 58% and a Ruppia spp. lagoon-wide cover of 57%. This was almost a doubling of the summer 2015 survey lagoon-wide macrophyte cover of only 30%* (Sutherland *et al.*, 2016). This increase partially reflects macrophyte re-colonisation following de-vegetation associated with the lagoon being open (Sutherland *et al.*, 2016). Although the 2015/16 summer macrophyte cover is within the Lagoon Technical Group (2013) target of >30-60%, the report notes *"there was still a high abundance of algae, both filamentous and phytoplankton, in the lagoon. Managing both the lagoon opening regime and nutrient loads entering into the lagoon from freshwater inputs will assist with managing both the macrophyte beds and algal growth"* (Sutherland *et al.*, 2016).

4.2 Awarua groundwater management zone

The pSWLP has delineated groundwater management zones for the Southland region and the applicants' property is located in the Awarua groundwater zone. The hydrogeological setting under the property is

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[3] It is also noted that the Waituna Lagoon monitoring results are not available on the Land, Air, Water Aotearoa website (www.lawa.org.nz/explore-data/southland-region/lakes/waituna-lagoon/) (28th November 2016)

interpreted to primarily consist of a relatively thin (mostly <20 metres) layer of poorly sorted clay-bound gravel deposits overlying thick, fine-grained Tertiary sediments of the East Southland Group (which includes the Gore Lignite Measures). The gravels host a shallow, unconfined aquifer that is recharged by rainfall infiltration with some localised surface water /groundwater interaction occurring near the stream margins.

Generally, groundwater quality in the Waituna area comply with limits set in the Drinking Water Standards for New Zealand (DWSNZ). Groundwater quality in the area around the applicants' property has been modelled by Environment Southland as having low denitrification potential based on geology, sediment geochemistry and geomorphology (Rissmann, 2011) which suggests shallow groundwater is susceptible to nitrate accumulation. However, Environment Southland (Rissmann, 2012) have identified groundwater quality under the property as having nitrate levels which reflect pristine, pre-European background levels (i.e. nitrate (as NO_3-N) between 0.01 – 0.4 mg/L) and minor to moderate land use impacts (i.e. nitrate between 1.0 – 3.5 mg/L), suggesting minimal impact of land use.

Regional time lag analysis (Chanut, 2014) shows the Waituna catchment has a total vertical travel time for nitrate of 3 to 5 years and eigenmodelling by Lincoln Ventures suggested Waituna has a very rapidly draining groundwater system with mean hydraulic storage residence times in the region of 1 to 8 weeks across the catchment.

Overall, there is some evidence to suggest groundwater nitrate concentrations in the general area can become elevated however the soils on the property indicate nitrate leaching risk is slight (which is consistent with the physiographic zones discussed in Section 2.2). The predominately imperfectly to poorly drained soils means denitrification potential within the soil zone is high but the amount of denitrification occurring is dependent on soil residence time.

4.3 Waituna Creek

The nearest Environment Southland surface water quality state of the environment (SOE) monitoring site to the applicants' property is located approximately 4.5 km downstream in a southwest direction (referred to as the Waituna Creek 1 metre upstream of Waituna Road[4]). There is also another SOE monitoring located in the downstream reaches of Waituna Creek at Marshall Road. The most recent available water quality monitoring data from the Waituna Creek catchment from the Land Air Water Aoteroa (LAWA) website are shown in Table 4. Unfortunately, no results were available when the website was checked in September and October 2016, so Table 4 summarises the results from the original consent application.

Table 4 shows that water quality in the Waituna Creek is relatively poor when compared against other SOE sites across New Zealand. Both sites show nitrogen levels are among the worst 25% of equivalent sites across the country, with the downstream site showing similarly poor results for phosphorus levels. The upstream site show *E.coli* levels are also amongst the worst 25% of equivalent sites. Within the past 5 years, water clarity appears to be improving in Waituna Creek however, nitrogen levels are deteriorating in the upstream site.

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[4] It is noted that the SOE monitoring site is referred to as the Waituna Creek at Mokotua in the 2010 SOE report however the site has since been renamed to the Waituna Creek 1m upstream of Waituna Road. Monitoring at this site ceased in July 2014.

Table 4: *Summary of the water quality in the Winton Stream compared nationally*

[Source: LAWA website, 18/06/2015. No information was available for Waituna Creek between October and November 2016]

Parameter	All NZ sites	All lowland rural sites	5 year trend	10 year trend
Waituna Creek 1m upstream of Waituna Road				
E.coli	Worst 25% of like sites	Worst 25% of like sites	No trend	No trend
Clarity (Black disc)	Worst 50% of like sites	Worst 50% of like sites	Meaningful improvement	No trend
Nitrogen (TN)	Worst 25% of like sites	Worst 25% of like sites	Meaningful degradation	No trend
Phosphorus (TP)	Worst 50% of like sites	Worst 50% of like sites	No trend	Meaningful improvement
Waituna Creek at Marshall Road				
E.coli	Worst 50% of like sites	Worst 50% of like sites	No trend	No trend
Clarity (Black disc)	Worst 25% of like sites	Worst 50% of like sites	Meaningful improvement	No trend
Nitrogen (TN)	Worst 25% of like sites	Worst 25% of like sites	No trend	No trend
Phosphorus (TP)	Worst 25% of like sites	Worst 25% of like sites	No trend	No trend

Environment Southland have recently assessed their SOE monitoring sites against the National Objectives Framework (NOF) in the NPSFM. Figure 5 shows that *E. coli* concentrations are generally good when compared to the NOF standards for secondary contact recreation (i.e. increased health risk (less than 1%) for wading or boating). Nitrate concentrations in the upstream are fair when compared to the NOF standards for nitrate toxicity (i.e. can have an impact on the 20% most sensitive species), improving to good downstream (i.e. can have an impact on the 5% most sensitive species). Macroinvertebrates (or fish food) are only monitored at the downstream monitoring site and the results are poor. While there are several potential causes for this, it is interpreted that at least in part, this reflects excessive nutrient inputs to the stream (as shown in Table 4).

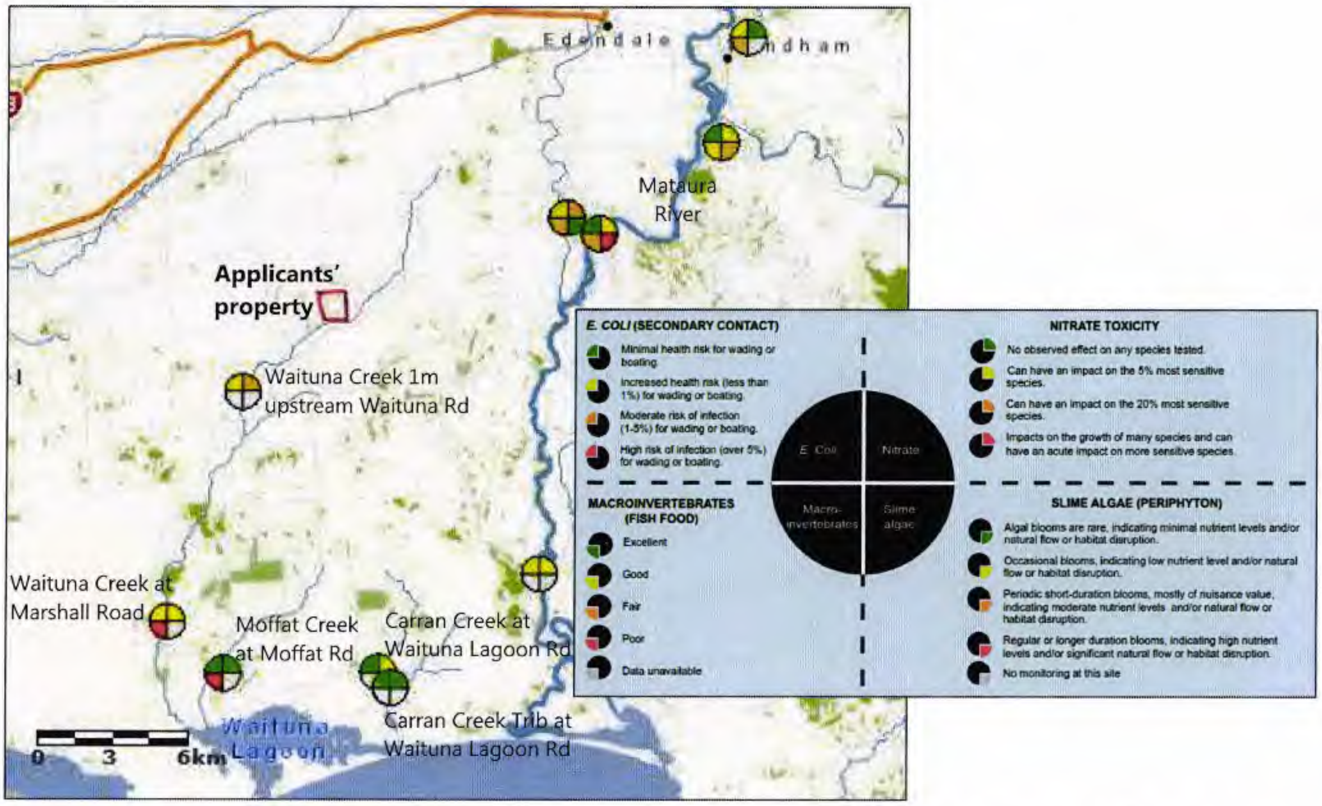

Figure 5: *National Objective Framework water quality (July 2009 – June 2014) for the Waituna Creek area*
[Source: Environment Southland BEACON website, 05/10/2016]

In summary, available data suggests water quality in the Waituna Creek is relatively poor, especially with respect to nutrient concentrations, with high nitrogen in the upper reaches of the catchment and high phosphorus concentrations in the lower reaches. The spatial distribution of nutrient inputs is discussed further in the following section.

4.3.1 Spatial distribution of nutrient inputs

Nutrient loads to the Waituna Lagoon are not evenly distributed across the catchment. Variability in land use and in inherent landscape properties (such as soil type and drainage properties, slope, elevation) mean some areas contribute disproportionally large proportions of the nutrient inputs.

There are several published conceptual models of the Waituna catchment which attempt to explain how inherent landscape properties influence spatial variation in nutrient loss to water quality. At a broad level, all models explain nutrient loss susceptibility as being highest for phosphorus loss in the southern portion of the Waituna Lagoon catchment where soil types are mostly organic and ASC (or P-retention) is low, and highest for nitrate loss in the mid to upper reaches of the Waituna Creek catchment where Brown (well-drained) soils overlie a shallow groundwater resource that rapidly exports nitrate to Waituna Creek. This is evident in the water quality data shown in Table 5 which shows that although the Waituna Creek only contributes approximately 33% of the total inflows, it discharges >70% of the total nitrogen (or nitrate) load. Because the applicants' property is located in the upper Waituna Creek catchment, it is in the area broadly associated with increased risk of nitrogen loss.

Table 5: *Source of freshwater inflows and nutrient loads to the Waituna Lagoon (derived from measured data)*

Freshwater source	Mean annual loads for 1995-2011[a]		Mean annual inputs for 2001-2011[b]			
	Total Nitrogen	Total Phosphorus	Flow	Nitrate (NO_3-N)	Organic Phosphorus	Phosphate Phosphorus (PO_4-P
Waituna Creek	80%	59%	33%	72%	36%	23%
Moffat Creek	8%	17%	7%	5%	9%	15%
Carran's Creek (including tributary)	12%	24%	11%	7%	15%	15%
Other surface water inflows*	Not assessed		22%	9%	20%	40%
Groundwater (direct to lagoon)			28%	8%	21%	7%

[a] Diffuse Sources and NIWA (2012)

[b] Hamilton *et. al*, (2012)

*Refers to areas not included in other surface inflows, and are similar to Moffat Creek and Carran's Creek tributary

The first of the conceptual models developed was Rissmann *et. al.*, 2012 who divided the mid to upper Waituna Creek catchment area into two distinct zones:

- the Mokotua Infiltration Zone (MIZ) largely between Mokotua and Caesar Road, was characterised by rapid infiltration of soil water with little or no attenuation of contaminants from overlying land use due to the reworking of soil and aquifer materials during a former sea level highstand during the last interglacial period (approximately 70,000 – 100,000 years ago). The movement of water through this zone is rapid (1-2 week mean residence time) and appears to contribute to the deterioration in water quality in Waituna Creek south of Mokotua. Because groundwater movement is so rapid, the risk of nitrate accumulating in the aquifer to excessive levels is relatively low.
- the Northern Waituna Zone north of Mokotua, was characterised as comprising thick, stoneless brown soils which buffer groundwater quality from the effects of land use due to cation exchange and chemical sorption processes which are aided by longer mean residence times (months). Shallow groundwater quality in this area shows little impact from land use with the main risk to water quality being from artificial drainage.

A third zone, referred to as the Southern Waituna Zone (SWZ), extended across the predominately wetland portion of the catchment south of Caesar Road, including both the Moffat and Carran Creek catchments. This area was characterised as being dominated by reducing groundwater conditions due to the abundance of organic carbon associated with wetland peat deposits and to a lesser extent lignite measures. The main risk to water quality in this zone was identified as being phosphate loss reflecting the leakiness of phosphate from organic soils, the naturally higher solubility and mobility of phosphate under reducing conditions and a potentially significant phosphate input from the underlying lignite measure aquifers.

Rekker and Wilson (2016) have reviewed this conceptual model incorporating new information predominately consisting of extensive surface water quality sampling and geophysical mapping. They conclude that *"to some extent we agree with the area of the MIZ as it identifies the main capture area of groundwater seepage to the surface water network within the Waituna catchment. However, the main area of nitrate infiltration to* *groundwater does not occur over this same area."* They identify the well-drained Waikiwi soils as being a more appropriate representation of the area susceptible to elevated nitrate loss. *"We are of the view the* [nitrate] *infiltration zone and discharge zone are distinct, and also not as strongly tied to the presence of the Q5 pale shore line."*

Another conceptual model for explaining spatial variation in nutrient loss are the physiographic zones discussed in Section 2.2 of this report and incorporated in the pSWLP. Rekker and Wilson (2016) state *"the oxidised geochemistry and permeable soil properties of the Waikiwi soil classes, plus the underlying aquifer are consistent with the nitrate leaching characteristics envisaged in the regional-scale* [Oxidising[5]] *zone assigned in physiographic mapping. Similarly, the heavier mineral and podzol soils have much less of a role as a gateway for nitrate to the groundwater system and waterways, and thus merit being grouped with the* [G]*leyed zonation."*

It is my conclusion the physiographic zones provide the most accurate representation for describing spatial variation in the susceptibility of nitrogen and phosphorus loss from land use on water quality. As the delineation of physiographic zones occurring within the Waituna catchment have largely been mapped on the basis on soil properties, the characterisation of the physiographic zones is largely consistent with the findings of Rekker and Scott (2016).

5 Effects of the proposal on water quality

5.1 Proposed activity

The proposed activity is described in full in the application. In summary, the application consists of changing the existing land use of beef and dairy support (young stock and cow wintering) to a dairy milking platform. The proposed maximum herd size is 306 milked cows which equates to a stocking rate of 2.97 cows/ha (based on a maximum effective farm area of 103 ha). The dairy operation will winter off the mature dairy cows and all young stock will be grazed off. The farm dairy effluent is to be discharged to land using a low rate irrigation system (Larall Smart Hydrant) at appropriate times (i.e. when soil moisture conditions are below field capacity which means storage will be required). A nutrient management plan for the proposal has been prepared by Roslin Consultancy Ltd along with a nutrient budget of the current land use and an alternative land use (i.e. specialist grazier). The alternative land use has not been considered in this report.

5.2 Water quality assessment

Nutrient loss from the existing land use (i.e. beef and dairy support), the proposed land use (i.e. dairy milking platform) have been estimated for the property using the Overseer® model (version 6.2.3) by Roslin Consultancy Ltd (November 2016). The modelled outputs have been summarised in Table 6 and indicate the proposed dairy conversion will reduce the nitrogen load lost from the property from 40 kg N/ha/year to 25 kg N/ha/year (or by 38%) while phosphorous loss will increase from 0.4 to 0.7 kg P/ha/year (or by 75%)[6]. The proposed losses are within the typical range for New Zealand dairy farms (i.e. measured phosphorus losses for dairy farms average 1.9 kg P/ha/year (Roberson *et al.*, 2011) and 24 to 42 N/ha/year for nitrogen (Roslin Consulting, 2016)).

Table 6: *Modelled whole farm nutrient losses*

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[5] Note: the name of the physiographic zone has been amended from that referred to in this report. To avoid confusion, the published physiographic naming convention has been used throughout this report.

[6] The property was modelled as comprising 87 ha of Woodlands soils and 16 ha of Dacre soils.

[Source: Roslin Consultancy Ltd, 2015]

Scenario	*Farm System*	*Nitrogen Loss (kg N/ha/yr)*	*Phosphorous Loss (kg P/ha/yr)*
Existing land use	Beef and dairy support	40	0.4
Proposed land use	Dairying of 306 cows (no wintering)	25	0.7

The Overseer outputs suggest the weighted average nitrogen concentration in drainage water will reduce from 8.6 mg/L to 5.6 g/m^3 under the proposed dairy conversion[7]. As most (>60%) of this loss is predicted to occur as leaching, the dominant form of nitrogen loss is interpreted to occur as nitrate. As such, the modelled farm loss for the proposed activity is well within (approximately 50%) the maximum acceptable value in the DWSNZ (Ministry of Health, 2008) and complies with the nitrate toxicity threshold in the NOF (bottom line of 6.9 g/m^3). With respect to ecological trigger levels, this concentration is higher than the Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines for fresh and marine water quality for physical and chemical stressors in slightly disturbed New Zealand freshwater ecosystems i.e. trigger value of <0.614 g/m^3 for total nitrogen (or <0.444 g/m^3 for nitrate-nitrogen). It is noted the modelled nutrient losses represent losses from farm before any attenuation, dilution or accumulation which may occur in receiving environments, and are therefore not an estimate of the environmental effect on water quality.

To assess the sensitivity of the proposal to soil type, the current and proposed land use scenarios were re-modelled in Overseer with the only change being soil type (and associated soil properties from S-map). The results, shown in Table 7, suggest that if the entire property comprised well-drained (Waikiwi) soil, nitrogen loss would increase by 1 kg N/ha/year. These results indicate the uncertainty in soil type (discussed in Section 2.1) has little influence over nitrogen losses and dominant contaminant transport pathways.

Table 7: *Difference in Overseer nitrogen loss assuming the whole farm comprises well drained (Waikiwi) soil*

Soil Types (S-map reference)	Soil description	Current N loss (kg N/ha/year)	Proposed N loss (kg N/ha/year)
Wood_29a.1 & Paro_4a.1	Mottled Firm Brown & Acidic Recent Gley	40	25
Waiki_34a.1	Typic Firm Brown	42	26

Overseer estimates dissolved (or filtered reactive phosphorus (FRP)) and total phosphorus (TP) in runoff, including surface and subsurface flows as one output, and reported as TP (Gray *et al.*, 2016). The model also assesses the risk of phosphorus loss from soil, fertiliser and effluent (with losses from drains included in the risk categories). Overseer block reports provided by Roslin Consultancy Ltd show the proposal has been categorised as having low phosphorus loss from soil, fertiliser and effluent across all individual blocks.

To provide context, Table 8 describes an estimate of TP as an average soil drainage concentration. Although not all phosphorus will be lost via dissolved form, the TP loss from Overseer has been used to provide a conservative estimate of potential effects. Table 7 shows the estimated TP concentration for the proposed activity ranges between 0.26 to 0.27 g/m^3 depending on which estimate of soil drainage is used. These concentrations are within the ANZECC trigger value for slightly disturbed New Zealand freshwater ecosystems i.e. <0.33 g/m^3 for TP (<0.10 g/m^3 for dissolved reactive phosphorus).

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[7] It was assumed the kale crop occurs within the Pastoral Woodlands block.

Table 8: *Estimation of phosphorus loss concentrations*

Parameter	*Description*	*Measurement*
Area	Effective farm area	103 ha
Soil drainage estimates	Waituna catchment (Rekker and Scott, 2016)	280 mm/year
	Waihopai groundwater zone median (Chanut, 2014)	292 mm/year
Modelled farm phosphorus loss	Current land use – beef and dairy support	47 kg P/year
	Proposed land use - dairying	78 kg P/year
Calculated concentration	Current land use – beef and dairy support	0.15 – 0.16 g/m^3
	Proposed land use - dairying	0.26 – 0.27 g/m^3
ANZECC total phosphorus trigger value		<0.33 g/m^3

Given the range of soils, geology and topography on the property, the main contaminant pathway is interpreted to be the rapid export of nutrients (nitrogen and phosphorus), microbes and sediment via artificial drains to McMillan Creek, which in turn drains into Waituna Creek and the Waituna Lagoon. Where there is sufficient residence time, some nitrogen may be attenuated within the soil zone on the property via denitrification.

Well drained soils (e.g. Waikiwi series) are prone to nitrate leaching to underlying groundwater, which then exports nitrate relatively rapidly (i.e. within months) to the surface water network. However, the regional soils mapping undertaken by Topoclimate South would suggest these soils make up a minor component of the property area, if they occur at all.

Contaminant losses via artificial drainage can be mitigated, to some extent, by adoption of good management practices. Table 9 summarises example good management practices for mitigations associated with the Gleyed physiographic zone on the property (Environment Southland, 2016). In general, all appropriate good management practices are to be adopted. The notable exceptions are constructing wetlands or sediment traps at the end of mole-pipe drains (which is not practical at all points on the property).

Table 9: *Key good management practices (GMPs) to reduce water quality impacts from the physiographic zones present on the property*

Physiographic Zone	Mitigation	GMPs	
General good management practices	Capture nutrients, sediments and microbes in wetlands and sediment traps	• It is understood there are no wetlands on the property and it is not intended to install sediment traps	×
	Nutrient management	• Nutrient budgets prepared	✓
		• Keep soil Olsen P levels at biological optimum; soil test regularly to check	✓
		• Use proof of placement for fertiliser and/or farm dairy effluent application	✓
	Riparian management	• Stock fenced out of waterways	✓
		• Culverts or bridges at regular stock crossings	✓
		• Riparian planting	✓
	Effluent management	• Appropriate land application area to ensure N and K returns are not excessive	✓
		• Increase storage volume, where needed *Is a new application, however the effluent pond has been sized using the Massey Calculator*	✓

		• Minimise effluent volumes at source (by reducing wash water volumes and rainwater in the system)	✓
		• Use low rate effluent methods where required *Larrell Smart Hydrant System is to be the dominant effluent irrigation system*	✓
Gleyed zone	Protect soil structure, particularly in gullies and near stream areas	• Use minimum or no-till cultivate practices such as direct drilling	✓
		• Match stock management to land use capability, e.g. avoid grazing heavy stock on steeper, more vulnerable soils, especially when wet	✓
	Reduce phosphorus use or loss	• Reduce use of P fertiliser where Olsen P values are above agronomic optimum	✓
		• Planting buffer zones	✓
	Reduce the accumulation of surplus N in the soil, particularly during autumn and winter	• Reduce inputs of N, such as fertiliser or nitrogen contained in imported feed	✓
		• Control the duration of grazing of pasture and forage crops (on-off grazing) *A feed/standoff on the property will allow some stock to have controlled grazing.*	✓
		• Winter stock off-paddock	✓
		• Plant catch crops to capture N from grazed winter forages (e.g. barley and triticale)	×
		• Optimise timing and amounts of irrigation input *Effluent irrigation to only occur when soil moisture is below field capacity*	✓
		• Substitute autumn diets with low-N feed (such as while crop silage)	×
		• Time N application to meet crop demand using split applications	✓
		• Re-sow areas of bare or damaged soil as soon as possible	✓
		• Reduce stock rate *Overall, the proposed change in land use may not represent a reduced stocking rate however the winter stocking rate will be much lower than currently occurs.*	×
	Avoid preferential flow of effluent through drains	• Defer effluent application when soil conditions are unsuitable	✓
		• Avoid placing effluent applications directly over tile drains *Low rate application will be used to minimise risk of contaminant loss via artificial drains*	×
		• Apply effluent at low rates and depths	✓
	Capture contaminants at drainage outflows	• Where landscapes allow, run tile drainage outflows into wetlands or sediment raps prior to entering ditches	×

5.2.1 Cumulative effects assessment

Regional scale modelling of nitrogen and phosphorous losses from agricultural land use in the Southland region by Aqualinc in 2014[8] showed:

- Adoption of mitigation measures on farms could result in reductions in nutrient loads discharged in Southland;
- Within the agricultural sector, nutrient loss from dairy farms make up a disproportionately large proportion of the nutrient load in most Southland catchments compared to the farm area;
- Adoption of mitigation measures on dairy farms alone significantly reduces catchment scale improvements in nutrient losses because sheep and beef farms make up the greatest area of land use[9]. Overall, contributions from both land uses are significant; and,
- Under the status quo of ongoing conversions and increasing production on dairy farms, water quality will not be maintained or improved in the long term even if very stringent mitigation requirements were to be adopted. Setting limits for catchment nutrient loads and then managing discharges to meet these limits appears to be the most appropriate method of ensuring the goal of maintaining and improving water quality in Southland will be achieved.

Although this study shows dairying is a significant contributor to nutrient loads in the Southland region, it does not take into account the receiving environment's assimilative capacity.

Table 10 provides a catchment perspective to nutrient loads, based on published estimates of nutrient inputs to the Waituna Lagoon. The difficulty with calculating aerial leaching rates from total instream loads is the source load is not evenly distributed across the catchment area. As was done in Rekker and Wilson (2016), it has also been assumed the total nitrate load in the Waituna catchment is sourced from the 1,420 ha of Waikiwi soils.

Table 10: *Waituna Creek total annual nitrate-nitrogen (NO_3-N) load to Waituna Lagoon*

Source	Method	Total Load (tonnes/year)	Total Catchment Aerial Load* (kg/ha/year)	Waikiwi Soils Aerial Load ** (kg/ha/year)
Diffuse Sources and NIWA (2012)	SOE monitoring data 1995-2011	108	6.7	75
Hamilton *et. al*, (2012)	SOE monitoring data 2001-2011	99.33	6.1	70
Rekker and Wilson (2016)	SOE monitoring data 2011-2015	131	8.1	92

*Aerial load has been calculated using a catchment area of 10,600 ha (catchment area for Waituna Creek at Marshall Road was provided by Environment Southland, H Rutter, *pers. comms*, 2016). Please note this includes no attenuation factors.
** No attenuation or correction factors have been applied.

Rekker and Wilson (2016) state that their estimate of 131 tonnes of nitrate-nitrogen per year equates to an average leaching rate of approximately 8.1 to 12.7 kg N/ha/year after attenuation, however it is unclear how

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[8] Aqualinc, 2014. *Assessment of Farm Mitigation Options and Land Use Change on Catchment Nutrient Loads*. Prepared for Environment Southland, report number C13055/04.

[9] Adoption of the M1 mitigation package on all farms (i.e. mitigations most easily implemented) reduced agricultural nitrogen loads by 18 – 32% however when only dairy farms adopted M1, nitrogen loads were reduced by only 1 – 6%. Similarly, when all farms adopted M3 (i.e. the most effective but most expensive mitigation measures), nitrogen loads were reduced by 29-37% and phosphorous loads by 40-80% however when only dairy farms adopted M3, nitrogen and phosphorous loads were reduced by 2-18% and 5-32% respectively.

attenuation has been assessed (particularly why instream loads appear to be greater than leaching rates). Similarly, when applying the total nitrate load to the area of Waikiwi soils in the Waituna Creek catchment, they state the aerial load is 42 to 64 kg N/ha/year, however, the calculation method has not been described. It is noted the modelled nitrogen loss of 25 kg/ha/year for the proposal is well below these loads.

Generally, differences in modelled land use losses and stream loads calculated from water quality monitoring data in Southland indicate an instream attenuation factor in the order of 30 to 50% (Snelder *et. al.*, 2014). Applying this Rekker and Wilson (2016), the annual nitrate load equates to an aerial leaching rate of 11 to 12 kg/ha/year across the entire Waituna Creek catchment area upstream of Marshall Road and 118 to 136 kg/ha/year when limiting losses to areas containing Waikiwi soils.

Figure 6 shows estimated nitrogen and nitrate loads to the Waituna Lagoon from Waituna Creek for the 1996 to 2012 period (Waituna Lagoon Technical Group, 2013). This plot suggests total nitrogen loads have increased from about 250 kg/day (or 91 tonnes/year) between 1999 and 2005 to about 800 kg/day (or 292 tonnes/year) between 2006 and 2012. Applied to the whole catchment area (and applying an in-stream attenuation factor of 30 to 50%), this equates to an aerial load of 11.2 – 12.9 and 35.8 – 41.3 kg TN/ha/year respectively. The proposed dairy conversion has a modelled total nitrogen loss of 25 kg N/ha/year which is more than the 1999-2005 average but less than the 2006-2012 average. Overseer modelling of 2014 agricultural land use across the Waituna Lagoon catchment area by DairyNZ suggests a median nitrogen farm loss of 37 kg N/ha/year, with a majority of losses occurring in the upper portion of the Waituna Creek catchment (Berger, 2016).

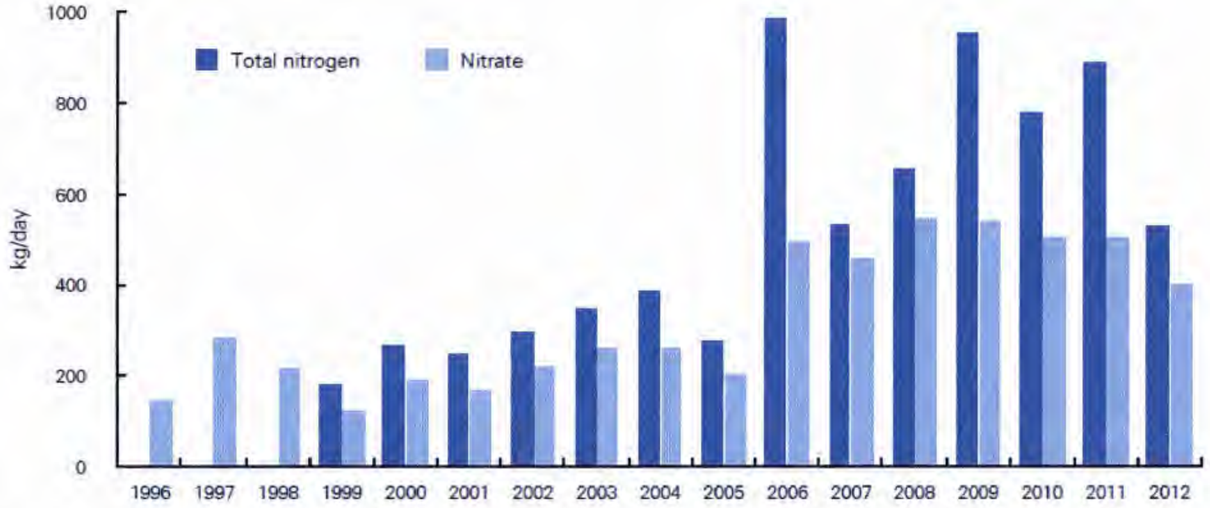

Figure 6: *Estimated daily nitrate and total nitrogen loads (expressed as kg/day) for Waituna Creek at Marshall Road (1996 to 2012). Based on collected samples from Environment Southland's water quality and flow monitoring programme.*

[Source: Extracted from Lagoon Technical Group, 2013]

Rekker and Wilson (2016) make an important observation with respect to the management of nitrogen loads to the Waituna Lagoon:

> *"The inference of short residence time in the order of a month or two should not come as a surprise to us in view of the relatively low retention of brown soils in the upper catchment, thin unsaturated zone overlying the groundwater table and parallel shallow transfer pathways for soil drainage (e.g. tile drains). This is an*

> *important conclusion to be able to make, since it suggests a nutrient transport process that resets the stored nitrogen each winter to spring period. The implication arising is that accumulation of nitrogen loads would not extend appreciably from one year to the next. In the context of the Waituna Lagoon eutrophication issues, management solutions that operate on nitrogen load reduction would have effect in a single seasonal cycle rather than taking many years to take effect."* (Rekker and Wilson, 2016).

This observation may help explain some of the relatively abrupt increase in estimated nitrogen loads between 2005 and 2006 in Figure 6.

Table 11 provides a catchment perspective to phosphorus mass loads, based on published estimates of inputs to the Waituna Lagoon. Using water quality monitoring data (which includes a small number of high flow sampling results), there is an average catchment total phosphorus aerial load of 0.6 kg/ha/year. This does not include any corrections for attenuation, accumulation or remobilisation of instream phosphorus. The proposed dairy conversion is modelled as having a total phosphorus loss of 0.7 kg/ha/year, which is slightly higher than the averaged catchment aerial load. However, similar to nitrogen, phosphorus source loads are not evenly distributed across the catchment area with various reports indicating most phosphorus is loss occurs in the lower portion of the catchment where there are organic soils (e.g. Robson *et. al.*, 2011; Rissmann *et. al.*, 2012). Similar results were found by DairyNZ based on Overseer modelling of 2014 land use across the Waituna Lagoon catchment area. They calculated a median farm phosphorus loss of 0.5 kg N/ha/year, with approximately two-thirds of the total loss occurring in the downstream catchment areas (equivalent to the Southern Waituna zone described in Section 4.3.1)[10].

Table 11: *Waituna Creek at Marshall Road total annual dissolved reactive phosphorus (DRP) and total phosphorus (TP) loads to Waituna Lagoon*

Source	Method	DRP		TP	
		Mass load (tP/yr)	**Aerial load* (kg/ha/yr)**	**Mass load (tP/yr)**	**Aerial load* (kg/ha/yr)**
Diffuse Sources and NIWA (2012)	SOE monitoring data 1995-2011	1.5	0.14	6.0	0.57

*Aerial load has been calculated using a catchment area of 10,600 ha (catchment area for Waituna Creek at Marshall Road was provided by Environment Southland, H Rutter, *pers. comms*, 2016). Please note this includes no attenuation factors.

Figure 7 shows estimated phosphorus loads to the Waituna Lagoon from Waituna Creek for the 1996 to 2012 period (Waituna Lagoon Technical Group, 2013). This plot suggests phosphorus loads have increased from an average of about 10 kg/day (or 3 tonnes/year) between 1999 and 2005 to about 40 kg/day (or 15 tonnes/year) between 2006 and 2012. Applied to the whole catchment area (and not accounting for instream attenuation), this equates to an aerial load of 0.34 and 1.4 kgTP/ha/year respectively. The proposed dairy conversion has a modelled total phosphorus loss of 0.7 kg N/ha/year which is more than the 1999-2005 average but less than the 2006-2012 average.

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[10] The median phosphorus loss from agricultural land use on organic soils was calculated to be 69 kg P/ha/year.

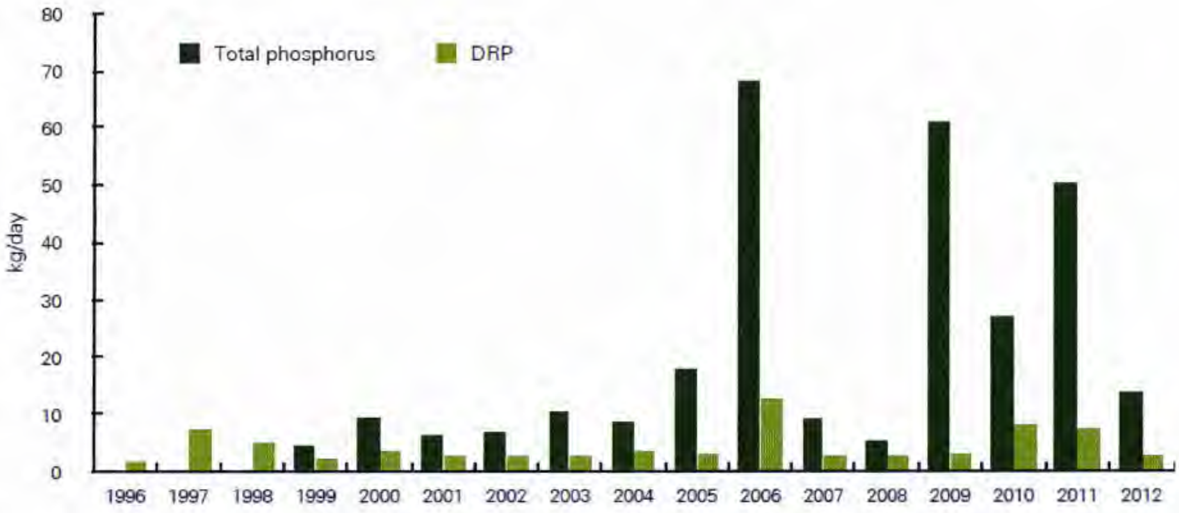

Figure 7: *Estimated daily dissolved reactive phosphorus (DRP) and total phosphorus loads (expressed as kg/day) for Waituna Creek at Marshall Road (1996 to 2012). Based on collected samples from Environment Southland's water quality and flow monitoring programme.*

[Source: Extracted from Lagoon Technical Group, 2013]

6 Summary

A water quality assessment has been undertaken for a proposed dairy conversion at Rimu-Seaward Down Road, Waituna. The applicant seeks to run a maximum herd size of 306 cows on a 103 ha (effective area) property located in the Waituna Lagoon catchment.

The Waituna Lagoon, which has international, national and local significance, has experienced a well-documented decline in ecological condition. In 2011 Environment Southland initiated an emergency response to reports which suggested there was an imminent risk of a regime shift to a degraded phytoplankton dominated state which would change the fundamental values and character of the lagoon (e.g. Hamill, 2011). In 2015, Environment Southland released a report by the Waituna Lagoon Technical Group (2013) which recommended a range of management targets including a maximum nutrient load limit of <125 tonnes/year for nitrogen (equivalent to a lagoon aerial loading of <90 kg N/ha/year) and <7.7 tonnes/year for phosphorus (equivalent to a lagoon aerial loading of <5.7 kg P/ha/year). It was estimated these nutrient loads were approximately 50% of the current (2013) catchment inputs to the lagoon.

The dominant soil types on the property are mapped as being Woodlands and Dacre soils. These soils are imperfectly to poorly drained and are prone to waterlogging. As a result, these soils are typically mole-piped drained as is the case on the applicants' property. The property is mapped as comprising the Gleyed (no variant) physiographic zones, meaning the main risk to water quality is the rapid export of nitrogen, phosphorus, sediment and microbes to surface waterways via artificial drainage. There may be some minor extent of Waikiwi soils on the property which are well-drained and vulnerable to nitrate leaching to underlying groundwater. Rekker and Scott (2016) consider most nitrate observed to occur in the Waituna Creek is sourced from land use overlying these soils. Modelling the current and proposed scenarios where the property comprises Waikiwi soils had little effect on the estimated nitrogen losses.

Available monitoring data suggests surface water quality in the Waituna Stream is generally fair to poor, with the highest concentrations of nitrate observed in the upper reaches and highest concentrations of phosphorus observed in the lower reaches. The applicants' property is located in the upper portion of the Waituna Creek which is associated with a greater risk of nitrogen loss.

Overseer modelling indicates the proposed dairy conversion will decrease nitrogen loss from the property to 25 kg N/ha/year (reduction of 38% from current land use) and will increase phosphorus loss to 0.7 kg P/ha/year (or increase of 75%). These losses are within the typical range for New Zealand dairy farms and equate to an averaged concentration of 6.3 g/m^3 for nitrogen and 0.26 to 0.27 g/m^3 for phosphorus (depending on what soil drainage estimate is used). These concentrations are within the drinking water standards and stream toxicity bottom lines for nitrate (11.3 and 6.9 g/m^3 respectively), and the ANZECC trigger value for ecological health for phosphorus (<0.33 g/m^3 for total phosphorus). The nitrogen concentration exceeds the ANZECC trigger value for ecological health for lowland stream for nitrogen (<0.66 g/m^3 for total nitrogen).

Nutrient loads to the Waituna Lagoon from the Waituna Creek have been calculated using water quality and flow monitoring data. The data show that although the Waituna Creek only contributes approximately 33% of the total inflows, it provides >70% of the total nitrogen (or nitrate) load. Depending on the monitoring period and methods used, mass nitrate loads range from 99 to 131 tonnes/year which is equivalent to a catchment aerial load of 11.2 to 12.9 kg/ha/year (using an instream attenuation factor of 30-50%). However, Rekker and Scott (2016) propose that a majority of this load is derived from land use overlying well-drained Waikiwi soils where nitrate is leached to underlying groundwater and rapidly exported to the Waituna Creek as baseflow. They state that if the instream loads are applied to the areas of Waikiwi soils, this equates to an aerial load of 42 to 64 kg N/ha/year (although the calculation method has not been described). The modelled nitrogen loss of 25 kg N/ha/year for the proposed dairy conversion is below this range. Rekker and Wilson (2016) observe that the accumulation of nitrogen loads does not extend appreciably from one year to the next due to rapid nutrient transport processes that reset the stored nitrogen each winter to spring period. This means land use changes to nitrogen losses would have an effect in a single season.

Although phosphorus loss occurs in dissolved and particulate forms, Overseer groups losses as one output. As a result, no assessment has been made on the potential effects different forms of phosphorus may have on water quality and ecological health. Estimates from monitoring data indicate the Waituna Creek catchment contributes an average of somewhere between 6.0 to 3-15 tonnes/year of total phosphorus. This equates to a catchment aerial load ranging between 0.3 to 1.4 kg/ha/year (not accounting for instream attenuation). The modelled phosphorus loss for the proposed dairy conversion is within this range (i.e. 0.7 kg/ha/year).

Although Overseer cannot be used to quantify water quality effects, the modelled outputs are the best available numerical assessment of nutrient discharge from the property, particularly for nitrogen. Nitrogen losses from the property are modelled as reducing under the proposal while phosphorus losses are modelled as increasing. If there is an increase in phosphorus loss from the property, it could contribute to additional periphyton growth and add to eutrophication issues in the Waituna Lagoon.

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 National Policy Statement for Freshwater Management, 2014), it is difficult to assess where the cumulative effect threshold applies in reference to an individual activity. This assessment has therefore been prepared using available information and has been assessed against the values and objectives in pSWLP.

Karen Wilson
Senior Environmental Scientist, Landpro Limited
7th December 2016

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Attachment E – Dairy Effluent Pond Design Report

RDAgritech

ENGINEERED BY NATURE

DAIRY EFFLUENT POND DESIGN REPORT

JOB TITLE	SCHRADER #2 EFFLUENT
ADDRESS	514 RIMU SEAWARD DOWNS ROAD OTERAMIKA
JOB NUMBER	50193
	19 June 2015

Client:	Schrader Mains Ltd 514 Rimu Seaward Downs Road RD1 Invercargill 9871
Planner:	Landpro PO Box 302 Cromwell 9342

TABLE OF CONTENTS

Prepared by	Reviewed by
Deborah Capper-Starr	David Rider
BSc (Earth)	BSc (Geol)
Engineering Geologist	Farm Dairy Effluent Design Specialist
	Senior Engineering Geologist/Geoprofessional

Schrader #2 Effluent Design Report REV2.docx

1. SYSTEM DESIGN SUMMARY

The Shed roof water will be excluded from the effluent system at all times.

Yard stormwater will be diverted from the effluent system into a field drain or channel during the months when cows are not being milked.

Farm Dairy Effluent (FDE) from the yard and shed will drain under gravity to a new 4 m x 3 m HYNDS precast stonetrap.

Solids removed from the stonetrap will be dried in a 6 m x 3 m concrete bunker to be constructed adjacent to the stonetrap. A dish drain will be installed at the front of the solids bunker, to direct the liquid fraction back into the stonetrap and allow the solids to dry adequately, prior to being applied to the effluent area.

Concrete aprons and hard fill will be installed to allow for all weather vehicle access to the stonetrap and solids drying bunker, and to prevent effluent contamination of the surrounding areas. The walls of the stonetrap will be extended up a nominal 300mm to prevent surface water from entering the trap and to prevent splashing of effluent during cleaning.

FDE will drain under gravity from the stonetrap to a new, 930 m^3 FDE deferred storage pond. The fill material for the pond construction will be mainly from the proposed pond excavation, with any shortfall being carted from the property's existing borrow pit.

FDE in the pond will be well mixed prior to discharge, using a horizontal thrust stirrer. This re-suspends and breaks up solids that would otherwise block the irrigation system and can either be shore or wharf mounted. At this stage the client's preference is for a wharf mounted DeLaval foot stirrer.

When conditions are appropriate for discharge, FDE will be applied to the land via a low application Larall Smart Hydrant.[1]

Table 1: Summary of the pond system information.

Type of distribution system proposed:	Low application:	Larall Smart Hydrant
Type of effluent to be distributed		Stirred, Raw
Coordinates of proposed pond (NZTM)	1264721 mE:	4851049 mN
Maximum expected for design		320
Type of dairy shed		Herringbone
Water use expected for design (two milkings/day)	60	Litres/cow/day
Daily volume FDE expected	19	m^3
Stormwater catchment area of yard & other areas	1,000	m^2
Total catchment area of proposed pond	690	m^2
Total catchment area for inclusion in pond design	1,690	m^2
Massey Pond Calculator design requirement (30 years)	940	m^3
TOTAL OPERABLE STORAGE volume of proposed pond	930	m^3
ESCOP Calc. 60 day storage requirement	918	m^3
Length of pond at top of bank	34.5	m
Width of pond at top of bank	20.0	m
Average depth of pond	2.5	m

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[1] RM Monaghan, DJ Houlbrooke and LC Smith (2010) *The use of low-rate sprinkler application systems for applying farm dairy effluent to land to reduce contaminant transfers*

[1] D J Houlbrooke (2006) *An assessment of soil aeration and K-line irrigation technology as management strategies to prevent overland flow of land applied farm dairy effluent.*

4 D J Houlbrooke, R M Monaghan & M McLeod (2010) *Matching farm dairy effluent storage requirements & management practices to soil & landscape features, AgResearch*

2. INTRODUCTION

2.1. SCOPE

This report describes the design and assessment conducted for a proposed dairy farm conversion at the above site, within the next five years. The farm is designing their dairy effluent systems to the current Farm Dairy Effluent (FDE) deferred storage requirements. This report has been produced utilizing the Massey Dairy Effluent Storage Volume Calculator, the Landcare Research website, Dairy NZ (FDE) Code of Practice, IPENZ Practice Note 21 and 27 and current industry best management practices.

The Client has engaged LandPro for consent processing and RDAgritech have been engaged to provide reporting for the design and construction of the FDE storage pond and effluent system, suitable for inclusion in the consent applications.

3. SITE ASSESSMENT

3.1. SITE CONSIDERATIONS

The farm is situated to the northeast of the Waituna Catchment and is made up of mainly flat land, with some sloping land along the waterway that flows diagonally through the centre of the property. The prevailing winds are from the west.

The property has been run as a dry stock and dairy support unit, with some existing infrastructure including an entrance lane and concreted stockyard, which could be converted for dairying purposes, with minimal adjustments being required. A 30 or 32 aside Herringbone shed and associated yards are proposed, with capacity for a maximum of 320 cows. These numbers were derived from the the Conversion Proposal completed by Roslin Cunsultancy Ltd, which states that the total number of cows to be milked will vary throughout the milking season as follows;

August	September	October	November	December
320	315	306	306	306
January	February	March	April	May
306	300	300	270	240

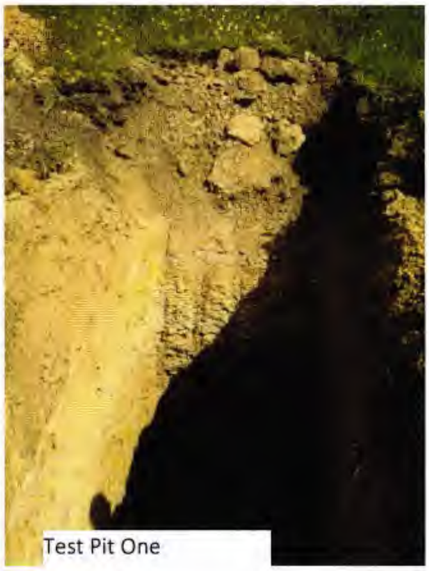
This results in an average of 306 cows across the milking season.

It is proposed that all young stock will be grazed off the property, with 70% of the dairy herd (~210 cows) being wintered off and approximately 4 Ha of kale grown on farm to be grazed by the remaining ~90 cows during June to September.

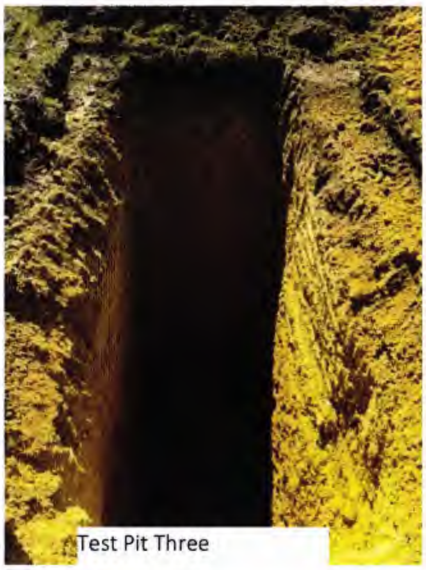
At this stage, no standoff pads or feedpads are planned, however allowance has been made in the pond sizing to accommodate a nominal 300 m^2 of extra catchment in the future.

3.2. SOILS INVESTIGATION

A soils investigation was undertaken on the 2nd December 2014, which included three (3) test pits and three (3) saturated conductivity (Ksat) tests and a site walkover to inspect existing soil exposures. A desktop study was also undertaken to identify soil types from the Environment Southland Topoclimate database.


Test Pit One


Test Pit Two


Test Pit Three

Two test pits were conducted at the proposed pond site, with an extra one being conducted at an alternative site on the northern side of the existing lane. The test pits encountered topsoil overlying Woodland soils, which are generally a SILT with small amounts of clay and some gravel. Alluvial gravels underlay the Woodland soils. Groundwater was encountered at 3.5 m in test pit 1 and perched groundwater was present in test pit 2 at 2.5 m. Groundwater was not encountered in test pits 3, however there was evidence of water at 2.4 m. The test log sheets in Appendix C describe soil types and depths in more detail. As it is not uncommon to encounter under-runners in the farm's locale, should any be encountered during construction of the FDE deferred storage pond, cutoff drains are to be installed to direct any subsurface water away from the pond; please refer to the Design Drawings in Appendix D.

Site soils investigations confirmed the soil characterisations arrived at from the desktop review.

Environment Southland's soil database identified two soil types across the farm and effluent application area; the technical data sheets for these soils are contained within Appendix C. Woodlands soils, which respond well to aeration and are the main soil type, cover the majority of the farm. Thin strips of Dacre soils are present in stream riparian margins however; as effluent will not be applied within 20 m of surface waterways these soils are not expected to receive effluent. For this reason, we have not included the Dacre soils in our discharge area assessment. We have however included the data sheets in Appendix C.

From the Topoclimate soils information technical data sheets;

- Woodlands soils have a Landscape Classification of "B" – Impeded drainage or low infiltration rate. These soils are classed as HIGH risk for effluent application at an application depth less than the soil water deficit and no exceeding 25mm per application using a low rate irrigator, or 10mm per application for a travelling irrigator. Woodlands soils are known for slight nutrient leaching.
- Dacre soils have a Landscape Classification of "C" – Sloping land (>7°) or hump and hollow drainage

Table 2: Each of the soils identified by the database and some of their relevant properties.

SOIL NAME	APPROX AREA (Ha)	STRUCTURAL COMPACTION	WATERLOGGING	SOIL RISK (flat terrain)	MEASURED Ksat (mm/hr)
Dacre	16	moderate	severe	high	-
Woodlands	87	moderate	moderate	high	1, 1, 16

Profile Available Water (PAW) for the property was based on information obtained from the Landcare Research website, and was estimated to be high across the Woodlands soils. A map generated from the Landcare Research website is contained in Appendix C.

Current industry research and accepted practice would suggest that deferred irrigation systems at low application rates would suit this particular farm and the soils present. Pulse/very low application irrigation can be utilised during the wetter months of autumn, winter and spring to keep the pond level low to maintain the deferral storage capacity if required. This irrigation should be balanced with the recommended soil monitoring to avoid irrigation on saturated soils.

3.3. RAINFALL

The Massey Pond Calculator is able to analyse the last 30 years of rainfall data and provide calculations on the maximum pond size that would have been required based on the depth of application and the volume of effluent discharged. The rainfall site of Waimahaka (1,149 mm) was used, rather than the closer site at Woodlands Garvie Road (1,031 mm), to bring the annual rainfall total closer to that used in the farm's nutrient budget (1,152 mm) that was undertaken by Roslin Consultancy Ltd. When rainfall events of high intensity or long duration occur these will cause surface water runoff and drainage through the soil. When FDE application is not appropriate, in situations such as this, deferred storage is required. We have checked the pond size against the woodlands site and the pond as designed is larger with the current site.

While we have allowed for irrigation to occur below field capacity, if extreme events occur outside the design capacity of this system (which require irrigation on soil above field capacity to prevent overtopping of the pond), then provided irrigation rates lower than the infiltration capacities (saturated conductivities) are used, research indicates that minimal, to no overland flow or leaching of nutrients would be expected.

4. DESIGN

The stonetrap and solids drying bunker will be installed in an existing area at the intersection of three laneways. This will allow for easy access by machinery for cleaning purposes. An all weather accessway and concrete apron will be installed to prevent effluent from flowing onto the surrounding area. The stonetrap inlet and outlet will be installed in such a way as to increase the residence time of the effluent. This will be achieved by placing both pipes at a 45-degree angle from the walls of the trap, causing the effluent to circulate before exiting the trap and allowing the heavier fraction to drop out of suspension.

Making use of the gravity available onsite will minimise the on-going time and monetary cost of maintenance, while constructing the FDE storage pond partially in-ground will reduce construction time and costs. The small amount of fill that may need to be brought in will be taken from the farm's existing, consented gravel pit.

A nominal 300m^2 has been included in the pond sizing undertaken for the farm. This allows for the possibility of a feedpad or silage pad in the long-term operation of the farm.

In order to know what the soil moisture conditions are prior to effluent discharge and as part of best management practice, we recommend the installation of soil moisture and temperature monitoring equipment (not aquaflex strips) and a weather station to record rainfall and ambient temperature across the effluent irrigation area. High and low level alarms in pump sumps and irrigator monitors and alarms are to be installed as needed. Proprietary monitoring systems such as Smart Farm and Regen systems would be ideal.

Local pump suppliers have quoted a maximum 8 hour response time should pumps fail and for a replacement to be installed. However in the mean time, backup generators and/or pumps could be used to ensure effluent is still able to be transferred to the pond or paddock.

A synthetic liner has been specified as the most robust solution for containing liquid in of the pond. For the purpose of providing clear drawings a 1.5mm HDPE liner has been shown on the drawings. Other products would be allowed only if the Design Engineer gives prior written approval. A 100mm thick, concrete based, sump hole in the pond is proposed to ensure no damage to the base where pumps and stirrers are to be fitted. The pump pontoons, suction intake or stirrer support will be able to rest on the base if necessary.

If pumps and stirrers are to be fitted at other locations in the pond then RDAgritech must be advised prior to pond construction.

Liner suppliers will need to provide a minimum 20-year warranty on durability, with installation of their systems in full accordance with their installation instructions. The liner installer is to install a uPVC inlet pipe as per the plans even if the shed pipe work is not installed at the time of installation.

Under the concrete pad in the pond sump is a non welded square of liner to act as a slip joint to protect the main liner from damage. It is essential that no stones or foreign objects be between the two contact surfaces.

4.1. DESIGN RATIONALE

The current pond sizing selected is based on the Massey calculator utilising a 1 in 30 year capacity limit, and we have used this as a more accurate measure of storage requirement than the ESCOP. As can be seen on the Summary Table, we have not taken the maximum pond size but rather a 1 in 30 year overtopping event. The Dairy NZ COP only requires a 1 in 10 year event to be considered, however we do not consider this suitable for these types of ponds. The calculator also doesn't currently give an output for the amount of stormwater included in the design on the summary report. However, it is accounted for in the design sizing.

If the instantaneous irrigation rate is higher than the Ksat value, the soil cannot absorb it fast enough. This will instigate ponding at the surface or drainage/sheet flow on the surface.

During the wetter parts of the year, the system can be pulsed to 1mm depth application rates. These low application depths allow a greater opportunity to irrigate during wetter times when the soil water deficit is likely to be low. These irrigation regimes will be utilised to maintain storage as required. Typically irrigation would occur until the nutrient limit for the soil is reached or the depth application specified in the Discharge Permit for an event is reached, whichever occurs first. On reaching this trigger level the pods would be moved to the next area. The irrigation contractor will determine the irrigation rationale in more detail and provide onsite training of staff to ensure they are suitably trained on its use.

Generally the creation of deferred storage in the form of ponds will allow the farmer to discharge when conditions suit to avoid having to irrigate using such a regime. However the pond and discharge parameters have been set to allow the above worst-case situation to be sustainably managed.

The storage pond should be irrigated from daily or when conditions allow and should not be used to defer irrigation when irrigation potential is present. The current design does not allow for deliberate storing of effluent in the pond outside the already excluded times as specificed in the pond design summary report from Massey. This includes holding effluent over winter and 5 days emergency storage. If irrigation potential is available outside these times, then irrigation should occur on every available day. This includes the winter months when, if irrigation potential exists then irrigation should occur to create storage for the impending spring.

Ponds of this size will stagnate and cause nuisance odour, as well as Biological Oxygen Demand problems when applied to the soil resulting in increased de-nitrification in the soil, unless oxygenated by means of mechanical stirring, or aeration of the fluid is conducted. This is also another reason why it is important to keep the pond as empty as possible. Pumped outlet nozzles discharging into sumps or ponds should be flared to provide a flat stream to maximise aeration.

Pond safety systems in accordance with The Department of Labour and best practice safety systems for a pond hazard of this type should be installed as part of the farm's health and safety policy, and management program. As a minimum, the wharf structure is to be fenced where it extends over the pond and have a buoy with 30 m of rope attached, the pond is to be suitably fenced and safety access ropes installed at the same locations as the safety stairs. The safety ropes should be inspected at least annually to ensure they have not been deteriorated by sun and moisture. All accessable areas with a health and safety risk shall be appropriatly signeposted.

4.2. IRRIGATION RATIONALE

Approximately 26 Ha of effluent disposal area is being utilised at this stage to allow the farmer the greatest potential to irrigate when possible.

During the spring and autumn wet months the irrigation system will be set to low application depths and utilising the pulsing 6 ports of the Larral system to distribute the effluent over a large area. These application rates will be adjusted by the farmer to suit the conditions. During the summer months the rate will be increased to the averaged maximum achievable by the low application irrigation setup.

While daily effluent of up to 18.9 m^3 is expected for the design we have specified an irrigation volume of 82 m^3 and 170 m^3 as the system must be capable of these outputs (within a 24 hour period) in order to reduce any deferred volume. The successful irrigation supply company will be providing the irrigation system details and components to meet the volume required. At this stage a Larall Smart Hydrant effluent irrigator is proposed and is subject to design by the irrigation contractor.

On no account should FDE be applied when surface water is ponding or during, 6 hours before, or 12 hours after heavy rainfall intensities of greater than 5 mm/hr. Combined with the soil moisture monitoring information, visual inspection of the proposed application areas must be conducted before each application to ensure conditions are suitable. Irrigation is to cease or be moved to a new area, if adverse conditions are present.

4.3. CLEANING AND REMOVAL OF SOLIDS

Solids from the stonetrap will be spread on the paddocks as required, observing best practice separation distances from sensitive areas and avoiding spreading of solids during adverse climatic conditions.

Prior to emptying the stonetrap, it should be agitated by using the yard wash down hose to mix the organics to a slurry and flush them out. This will greatly reduce the organics that need to be removed from the stonetrap. These solids can then be cleaned out and dumped into the new solids drying bunker to dry before spreading on paddocks. The heavier stones/sand should remain in the stonetrap. Once the milking season finishes, the stonetrap should be hosed to remove any FDE remaining, then the stones/sand that have built up can be removed and drained, prior to spreading on lanes.

A water hydrant connection is to be installed near the pond crest to allow washing down of any sludge that may build up, into the sump in the base of the pond.

The frequency of cleaning is dependent on use. It may take a few seasons to establish a suitable cleaning regime.

Ideally, prior to the stonetrap being cleaned the stored sludge on the stone dump area should be spread to paddock if conditions are suitable.

5. RECOMMENDATIONS FOR PASTURE MANAGEMENT AND IRRIGATION

As part of best management practice, a pasture management regime involving aerating of effluent paddocks should be introduced, particularly if pugging and/or waterlogging of the soils has occurred in paddocks. As shown in the research reporting mentioned above, aeration greatly improves the soil's ability to hold and process nutrients from FDE, which also provides for a 'healthier' soil matrix.

RDAgritech recommend that aeration, or re-pasturing, of the topsoil profile should be carried out immediately on any effluent paddocks that have suffered compaction, or pugging, due to stock. This will re-establish the permeability of the soil and reduce overland drainage runoff.

6. HEALTH AND SAFETY

All work must be in compliance with the Health and Safety in Employment Act. The following table from *IPENZ Practice Note 21: Farm Dairy Effluent Ponds* summarizes minimum hazard mitigation required around FDE ponds.

HAZARD MITIGATION AROUND FDE PONDS	
Fencing	Permanent and secure fencing to prevent stock and children from accessing FDE pond areas.
Gates	Lockable Access gates
Emergency Escape options	Permanent ladders and escape ropes.
Rescue buoy	A rescue buoy or similar on a rope that can be thrown to a person in the pond to help them keep afloat.
Anchor points	Anchor points to attach floating pontoons (if used) to improve stability.
Signage	Hazards on site clearly shown

The pond and any sumps including stonetraps that pose a health and safety hazard of falling, drowning and/or entrapment shall be fully fenced as deemed appropriate by the principle's Health and Safety Policy on farm. The fencing should be appropriate for the hazards, stock, personnel and accessibility by the type of individuals likely to enter the site. Guidance on fencing systems can be obtained on the Dairy NZ website.

7. APPLICABILITY

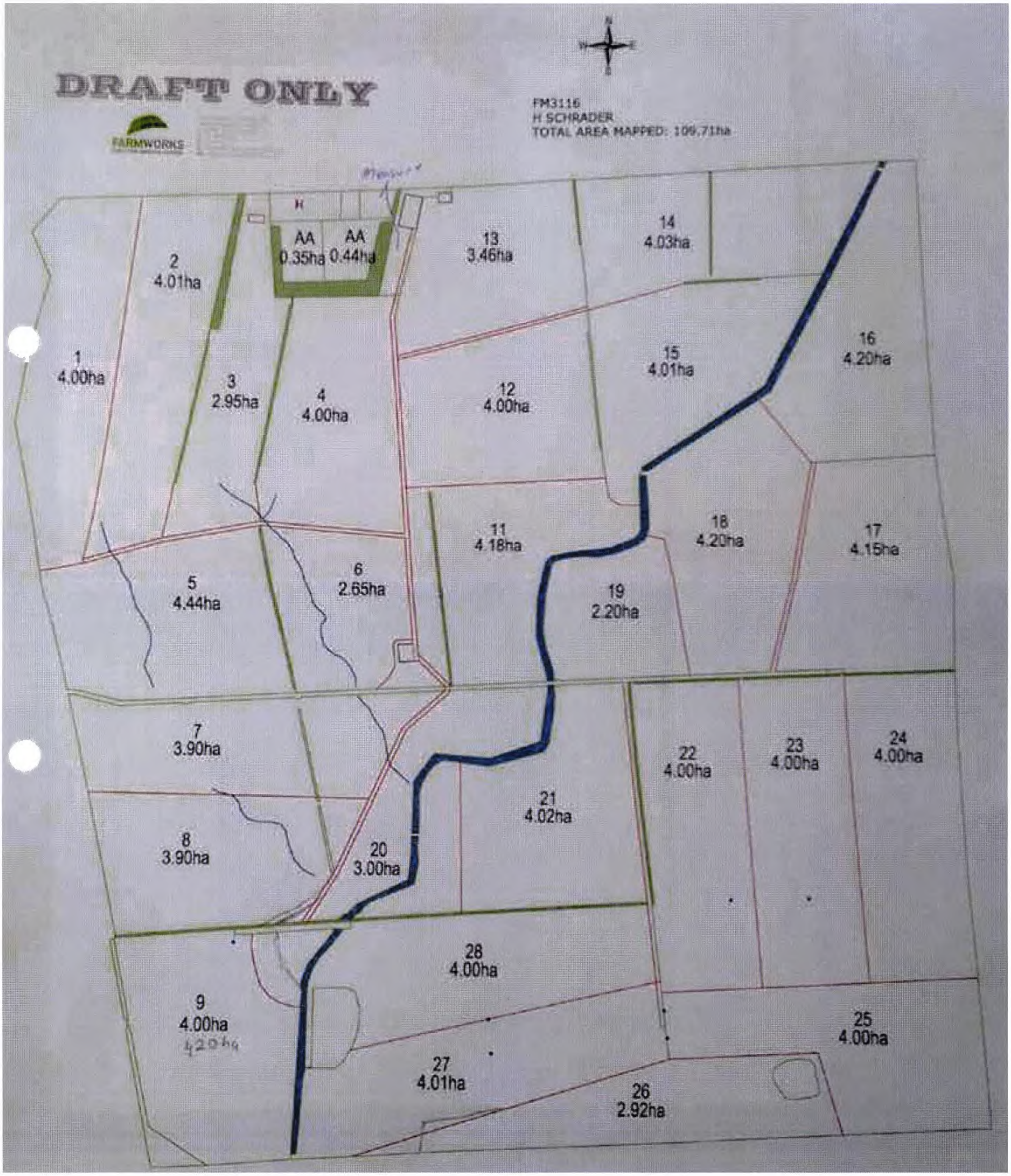
This report has been prepared based on the information provided to us by the Client or their representative. The design is iterative whereby changes can affect the entire design outcome. We must be notified of any potential changes to confirm the design is not compromised.

While we have exercised due care in assessing the pond size, we take no responsibility for the Massey pond calculator results. This is a proprietary software package still under development and is subject to vetting by its developers and reviewers.

This report is only to be used by the parties named above for the purpose that it was prepared and shall not be relied upon or used for any other purpose without the express written consent of RDAgritech Ltd

APPENDIX A. SITE PLANS

1. Proposed Farm Map



DRAFT ONLY

FM3116
H SCHRADER
TOTAL AREA MAPPED: 109.71ha

APPENDIX B. MASSEY DAIRY EFFLUENT STORAGE CALCULATOR REPORT

Note:

The Massey Pond Calculator is able to analyse the last 30 years of rainfall data and provide calculations on the maximum pond size that would have been required based on the depth of application and the volume of effluent discharged. When rainfall events of high intensity or long duration occur, these will cause surface water runoff and drainage through the soil. When FDE application is not appropriate in situations such as this, deferred storage is required.

The current pond sizing selected is based on the Massey Pond Calculator, utilising a 1 in 30 year capacity limit and RDAgritech have used this as a more accurate measure of storage requirement than the ESCOP. As can be seen on the summary sheet, we have not taken the maximum pond size but rather a 1 in 30 year overtopping event. The new DairyNZ COP only requires a 1 in 10 year event to be considered, however we do not consider this suitable for these types of ponds. The calculator also does not currently give an output for the amount of stormwater included in the design on the summary report, however it is accounted for in the design sizing.

Dairy Effluent Storage Calculator
Summary Report

Regional authority:	Environment Southland
Authorised agent:	RDAgritech - DCS
Client:	Schrader Mains Ltd
Program version:	1.44
Report date:	Wednesday, 10 June 2015
General description:	

A maximum of 320 cows and a wash down water volume of 60 litres/cow/day was assumed. The actual volumes were based on the Roslin Consultancy Ltd Conversion Proposal, which details the number of cows per month.

The rainfall site of Waimahaka (1,149 mm) was used rather than the closer site at Woodlands Garvie Road (1,031 mm), to bring the annual rainfall closer to that used in the farm's nutrient budget (1,152 mm). This translates to a larger pond than if the closer site was used.

The area of effluent block is also as detailed in the Roslin Consulting Ltd Conversion Proposal.

The catchment area of the proposed milking shed yard is estimated to be 700 m^2. The yard is to be diverted from the 1st of June to the 31st of July.

The milking shed roof (~243 m^2) is to be permanently diverted from the pond.

A low rate Larral Smart Hydrant system is proposed. The flow rate for this system is approximately 20 m^3/hour. The system will run for around 10 hours each day (a volume of 200 m^3) with a maximum daily depth of 20 mm, based on a 6 port Larral applying 2 mm depth per hour.

To allow for possible future expansion, a nominal 300 m^2 has been included in the design for a future feedpad and the pond size was increased to 930 m^3 which is achieved through a 34.5 m x 20 m x 2.5 m pond with a 2:1 batter on the embankments.

This volume is calculated on the assumption that no irrigation occurs from the 1st of June until the 31st of July. An additional 5 days of storage has been allowed for emergencies such as pump break down. The pond also has a freeboard allowance of 300 mm.

The consent will need to provide for the ability to irrigate all year round to ensure that in adverse years, some irrigation may occur over winter to enable storage to be available for spring.

Climate

Rainfall site:	Waimahaka
Mean annual rainfall:	1149 mm/year

Effluent Block

Area of low risk soil:	0.0 hectares
Minimum area of high risk soil:	26.0 hectares
Surplus area of high risk soil:	0.0 hectares

Wash Water

Yard wash:

- No. of cows milked in spring:	320 cows
- Milking time:	5 hrs/day
- Yard wash volumes:	Custom average daily values (cubic metres/day)
- Season start:	10 August
- Season end:	31 May

Month	**Wash Volume (cubic metres)**
January	18.4
February	18.0
March	18.0
April	16.2
May	12.0
June	0.0
July	0.0
August	16.0
September	18.9
October	18.4
November	18.4
December	18.4

Irrigation

Winter-spring depth:	2 mm
Spring-autumn depth:	20 mm
Winter-spring volume:	82 cubic metres
Spring-autumn volume:	170 cubic metres
Irrigate all year?	No
Don't irrigate start:	01 June
Don't irrigate end:	31 July

Catchments

Yard area:	700 square metres
Diverted?	Yes
- diversion start:	01 June

- **diversion end:** 01 August

Shed roof area: 243 square metres

  Diverted? Yes

Feedpad area: 0 square metres

  Covered? No

  Diverted? No

Other areas: 300 square metres

Storage

Pond/s present? Yes

No. of ponds: One pond

Includes irregular ponds? No

Pond 1

- **total volume:** 1127 cubic metres
- **pumpable volume:** 930 cubic metres
- **surface area:** 690 square metres
- **pumped?** Yes

Emergency storage period: 5 days

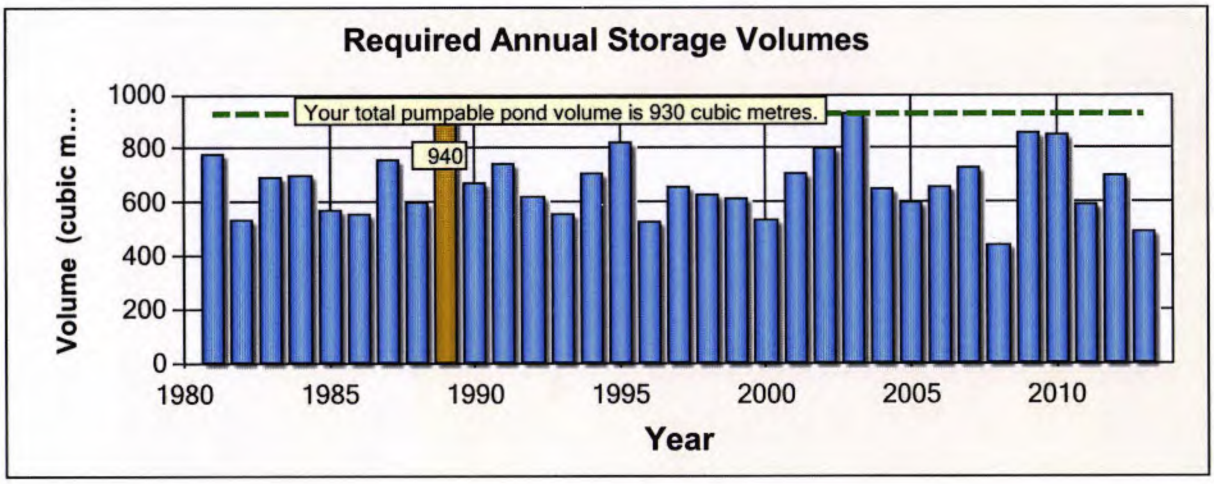
Outputs

Maximum required volume: 940 cubic metres

90 % probability volume: 834 cubic metres

During the period from: 01 July 1980

To: 30 June 2013



RDAgritech Deferred Irrigation Rationale

The Pond Storage Calculator (PSC) will only irrigate on days when a soil water deficit (SWD) equal to, or greater than the depth entered in the depth field is available. RDAgritech has found that areas of Southland have very low available SWD during autumn, winter & spring.

RDAgritech has concluded (in agreement with the scientific research available) that with good management practice and our deferred irrigation approach (as described above) nutrient leaching will be mitigated even if the soil is above field capacity, provided only low depth, low rate irrigation occurs.

Guidance on application of FDE to various soil types is presented in "Matching Farm Dairy Effluent Storage Requirements and Management Practices to Soil and Landscape Features" by DJ Houlbrooke, et al. Relevant concepts from this report regarding FDE application on soils at field capacity are paraphrased below.

- Low application rates increase the likelihood of matrix flow and allow a greater volume of Farm Dairy Effluent (FDE) to move through smaller pores in the soil. This allows greater attenuation of nutrients in the root zone.
- Fine-grained "High-Risk" soils typically have a high water holding capacity. If infiltration through the soil is primarily via matrix flow, soils with a higher water holding capacity will require greater application depths to instigate drainage below the root zone.
- During matrix flow, surface water inputted at the surface of the soil will primarily displace water situated deeper in the root zone. Thus FDE applied will remain in the root zone with sufficient residence time for nutrient attenuation and direct losses of nutrients should be negligible.

RDAgritech's standard practice is to map the soils on farm and assess soil type and infiltration across the farm's effluent block.

APPENDIX C. SOILS INFORMATION

1. Permeameter Log Sheets SK1-SK3
2. Test Pit Log Sheets TP1-TP3
3. Soils Types & Classifications Map
4. Landcare Research PAW Map
5. Soil Testing Location Plan
6. Soils Data Sheets
    a. Dacre Soils
    b. Woodlands Soils

Field Auger/Permeameter Test Sheet

RDAgritech
ENGINEERED BY NATURE

Project:	Schrader #2 Effluent		
Site Location:	514 Rimu Seaward Downs Road		
Test Number:	SK-1 in BH-1	Test Date:	2-Dec-14
Operator:	DCS	Test Time:	12:46 pm
Auger Ø:	10 cm	Permeameter Ø ID:	4.2 cm
Depth of Auger Hole:	0.5	Average Hole Ø:	11.5 cm

Auger Log E 1262584 N 4847864

DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	GROUND WATER
0.1 0.2 0.3	ψψψψψψ ψψψψψψ ψψψψψψ ψψψψψψ ψψψψψψ ψψψψψψ	SILT; organics; friable; mid-brown; no worms	D/M	Topsoil	none
0.4 0.5	xxx..xxx..xxx xxx..xxx..xxx xxx..xxx..xxx xxx..xxx..xxx	SILT; very minor clay; very minor plasticity; orangey grey/brown		Woodlands Soils	
0.6 0.7		End of Borehole; no groundwater encountered			

$$K_{sat} = \frac{4.4Q\left[0.5\sinh^{-1}\left(\frac{H}{2r}\right) - \sqrt{\left\{\left(\frac{r}{H^2}\right) + 0.25\right\}} + \frac{r}{H}\right]}{2\pi H^2}$$

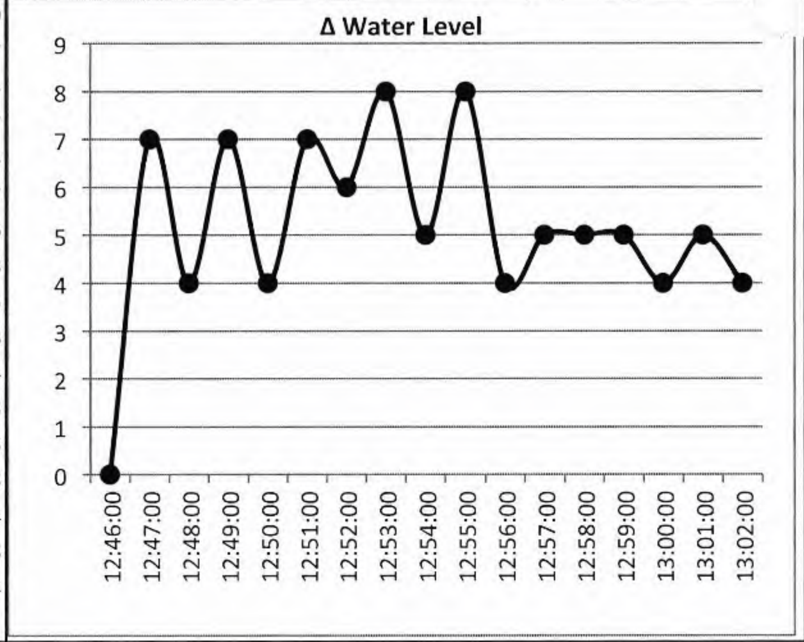
Ksat = 1 mm/hr

Permeameter Readings

Permeameter test was conducted between 0.2m and 0.5m

Water Level in hole 300mm

Time	Δ Time (hr)	Water Level (mm)	Δ Water Level (mm)
12:46:00	0	612	0
12:47:00	0:01:00	619	7
12:48:00	0:01:00	623	4
12:49:00	0:01:00	630	7
12:50:00	0:01:00	634	4
12:51:00	0:01:00	641	7
12:52:00	0:01:00	647	6
12:53:00	0:01:00	655	8
12:54:00	0:01:00	660	5
12:55:00	0:01:00	668	8
12:56:00	0:01:00	672	4
12:57:00	0:01:00	677	5
12:58:00	0:01:00	682	5
12:59:00	0:01:00	687	5
13:00:00	0:01:00	691	4
13:01:00	0:01:00	696	5
13:02:00	0:01:00	700	4



Field Auger/Permeameter Test Sheet

Project:	Schrader #2 Effluent		
Site Location:	514 Rimu Seaward Downs Road		
Test Number:	SK-2 in BH-2	Test Date:	2-Dec-14
Operator:	DCS	Test Time:	1:39 pm
Auger Ø:	10 cm	Permeameter Ø ID:	4.2 cm
Depth of Auger Hole:	0.5	Average Hole Ø:	11.5 cm

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Auger Log E 1262584 N 4847864

DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	GROUND WATER
	ψψψψψψ	SILT; organics; friable; mid-brown; some worms	D/M	Topsoil	none
0.1	ψψψψψψ				
	ψψψψψψ				
0.2	ψψψψψψ				
	ψψψψψψ				
0.3	ψψψψψψ				
	xxx..xxx..xxx	SILT; very minor clay; very minor plasticity; orangey grey/brown		Woodlands Soils	
0.4	xxx..xxx..xxx				
	xxx..xxx..xxx				
0.5	xxx..xxx..xxx				
		End of Borehole; no groundwater encountered			
0.6					
0.7					

$$K_{sat} = \frac{4.4Q\left[0.5\sinh^{-1}\left(\frac{H}{2r}\right) - \sqrt{\left\{\left(\frac{r}{H^2}\right)+0.25\right\}} + \frac{r}{H}\right]}{2\pi H^2}$$

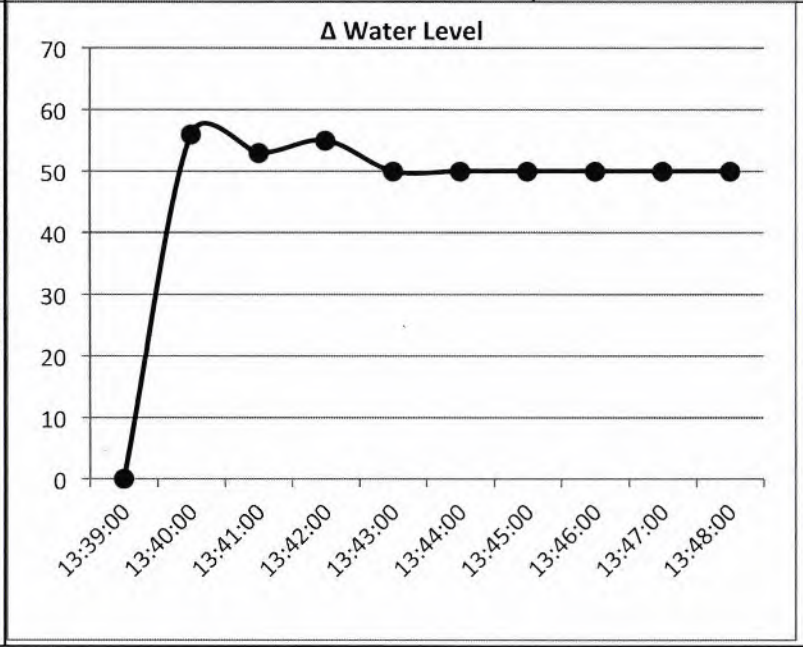
Ksat = 16 mm/hr

Permeameter Readings

Time	Δ Time (hr)	Water Level (mm)	Δ Water Level (mm)
13:39:00	0	156	0
13:40:00	0:01:00	212	56
13:41:00	0:01:00	265	53
13:42:00	0:01:00	320	55
13:43:00	0:01:00	370	50
13:44:00	0:01:00	420	50
13:45:00	0:01:00	470	50
13:46:00	0:01:00	520	50
13:47:00	0:01:00	570	50
13:48:00	0:01:00	620	50

Permeameter test was conducted between 0.2m and 0.5m

Water Level in hole 300mm



Field Auger/Permeameter Test Sheet

RDAgritech
ENGINEERED BY NATURE

Project:	Schrader #2 Effluent		
Site Location:	514 Rimu Seaward Downs Road		
Test Number:	SK-3 in BH-3	Test Date:	2-Dec-14
Operator:	DCS	Test Time:	2:32 pm
Auger Ø:	10 cm	Permeameter Ø ID:	4.2 cm
Depth of Auger Hole:	0.5	Average Hole Ø:	11.5 cm

Auger Log E 1262584 N 4847864

DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	GROUND WATER
0.1 0.2 0.3	ψψψψψψ ψψψψψψ ψψψψψψ ψψψψψψ ψψψψψψ ψψψψψψ	SILT; organics; friable; mid-brown; no worms	D/M	Topsoil	none
0.4 0.5	xxx..xxx..xxx xxx..xxx..xxx xxx..xxx..xxx xxx..xxx..xxx	SILT; very minor clay; very minor plasticity; orangey grey/brown		Woodlands Soils	
0.6 0.7		End of Borehole; no groundwater encountered			

$$K_{sat} = \frac{4.4Q\left[0.5\sinh^{-1}\left(\frac{H}{2r}\right) - \sqrt{\left\{\left(\frac{r}{H^2}\right) + 0.25\right\}} + \frac{r}{H}\right]}{2\pi H^2}$$

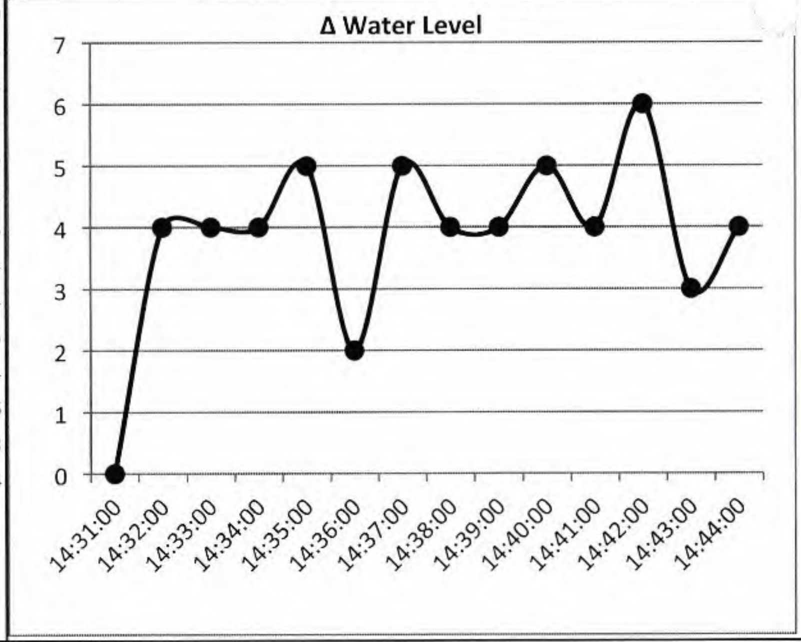
Ksat = 1 mm/hr

Permeameter Readings

Permeameter test was conducted between 0.2m and 0.5m

Water Level in hole 300mm

Time	Δ Time (hr)	Water Level (mm)	Δ Water Level (mm)
14:31:00	0	163	0
14:32:00	0:01:00	167	4
14:33:00	0:01:00	171	4
14:34:00	0:01:00	175	4
14:35:00	0:01:00	180	5
14:36:00	0:01:00	182	2
14:37:00	0:01:00	187	5
14:38:00	0:01:00	191	4
14:39:00	0:01:00	195	4
14:40:00	0:01:00	200	5
14:41:00	0:01:00	204	4
14:42:00	0:01:00	210	6
14:43:00	0:01:00	213	3
14:44:00	0:01:00	217	4



TP-1

TEST PIT LOG

RDAgritech
ENGINEERED BY NATURE

JOB NUMBER: 50193
PROJECT: Schrader #2 Effluent
LOCATION: 514 Rimu Seaward Downs Road
CO-ORDINATES:
Refer Investigation Site Plan
HOLE STARTED: 2-Dec-14
HOLE FINISHED: 2-Dec-14
ELEVATION:
OPERATOR: Michael Kollat
DATUM:
COMPANY: Cameron Contracting Ltd
EQUIP.: SH210

ENGINEERING DESCRIPTIONS							GEOLOGICAL
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
				ψψψψψψ ψψψψψψ ψψψψψψ	SILT; organics, dark brown	M	Topsoil
			0.4 0.8	XXOXXOXXO XXOXXOXXO XXOXXOXXO XXOXXOXXO XXOXXOXXO XXOXXOXXO	SILT; Gravelly; very minor clay; friable		Woodlands Soil
				0o0oo0oo	GRAVEL; ~0.1 m thick layer of white, rounded gravels		Alluvial Gravels
			1.2	XOXOXXOXX XOXOXXOXX XOXOXXOXX XOXOXXOXX XOXOXXOXX	SILT; gravelly; gravel sub-rounded to rounded, some cobbles up to 150 mm; greyish Perched water entering pit at 1.5 m		
			1.6 2.0 2.4 2.8 3.2	oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo	GRAVEL; fine to medium; some gravel to 100 mm; some clay; orangey	M/W	
	▼		3.6 4.0	oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo oo-0oo-oo	Groundwater entering pit at 3.5 m	W	
				x.-.-xo.-.xo x.-.-xo.-.xo	SAND; silty, clayey; moderate amount of medium, rounded gravel End of test pit at 4.5 m depth		

OTHER COMMENTS:

PHOTO REF.:

Logged By: DCS
Checked Date: 10-Feb-15
Sheet: 1 of 1

TP-2

TEST PIT LOG

RDAgritech
ENGINEERED BY NATURE

JOB NUMBER:	50193	PROJECT:	Schrader #2 Effluent
		LOCATION:	113B Cotter Ave
CO-ORDINATES:		HOLE STARTED:	2-Dec-14
Refer Investigation Site Plan		HOLE FINISHED:	2-Dec-14
ELEVATION:	m	OPERATOR:	
DATUM:		COMPANY:	Cameron Contracting Lt EQUIP.: SH210

ENGINEERING DESCRIPTIONS							GEOLOGICAL
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
				ψψψψψψ ψψψψψψ	SILT; organics, dark brown	M	Topsoil
			0.4	xxoxxoxxo xxoxxoxxo xxoxxoxxo	SILT; Gravelly; very minor clay; friable		Woodlands Soil
			0.8 1.2	xoxoxxoxx xoxoxxoxx xoxoxxoxx xoxoxxoxx xoxoxxoxx xoxoxxoxx xoxoxxoxx xoxoxxoxx xoxoxxoxx xoxoxxoxx	SILT; gravelly; gravel sub-rounded to rounded, some cobbles up to 150 mm; greyish		Alluvial Gravels
			1.6 2.0 2.4	oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo	GRAVEL; fine to medium; some gravel to 100 mm; some clay; orangey	M/W	
			2.8 3.2 3.6 4.0	oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo oo-Ooo-oo	Perched water entering the pit at 2.5 m	W	
				oo-Ooo-oo	End of test pit at 4.5 m depth		

OTHER COMMENTS:	Logged By:	DCS
	Checked Date:	10-Feb-15
PHOTO REF.:	Sheet:	1 of 1

TP-3

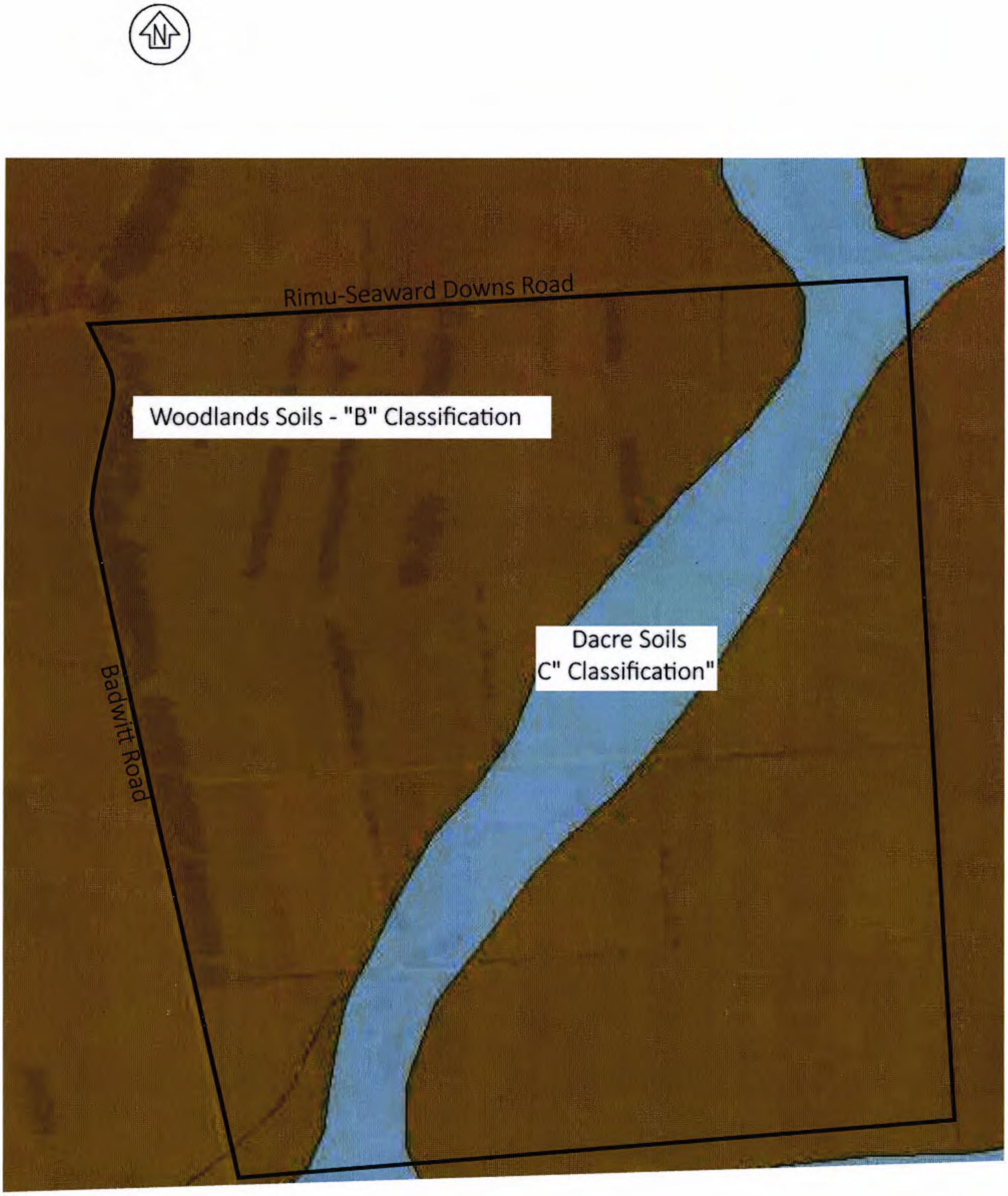
TEST PIT LOG

RDAgritech
ENGINEERED BY NATURE

JOB NUMBER:	50193	PROJECT:	Schrader #2 Effluent
		LOCATION:	113B Cotter Ave
CO-ORDINATES:		HOLE STARTED:	2-Dec-14
Refer Investigation Site Plan		HOLE FINISHED:	2-Dec-14
ELEVATION:	m	OPERATOR:	
DATUM:		COMPANY:	Cameron Contracting Lt EQUIP.: SH210

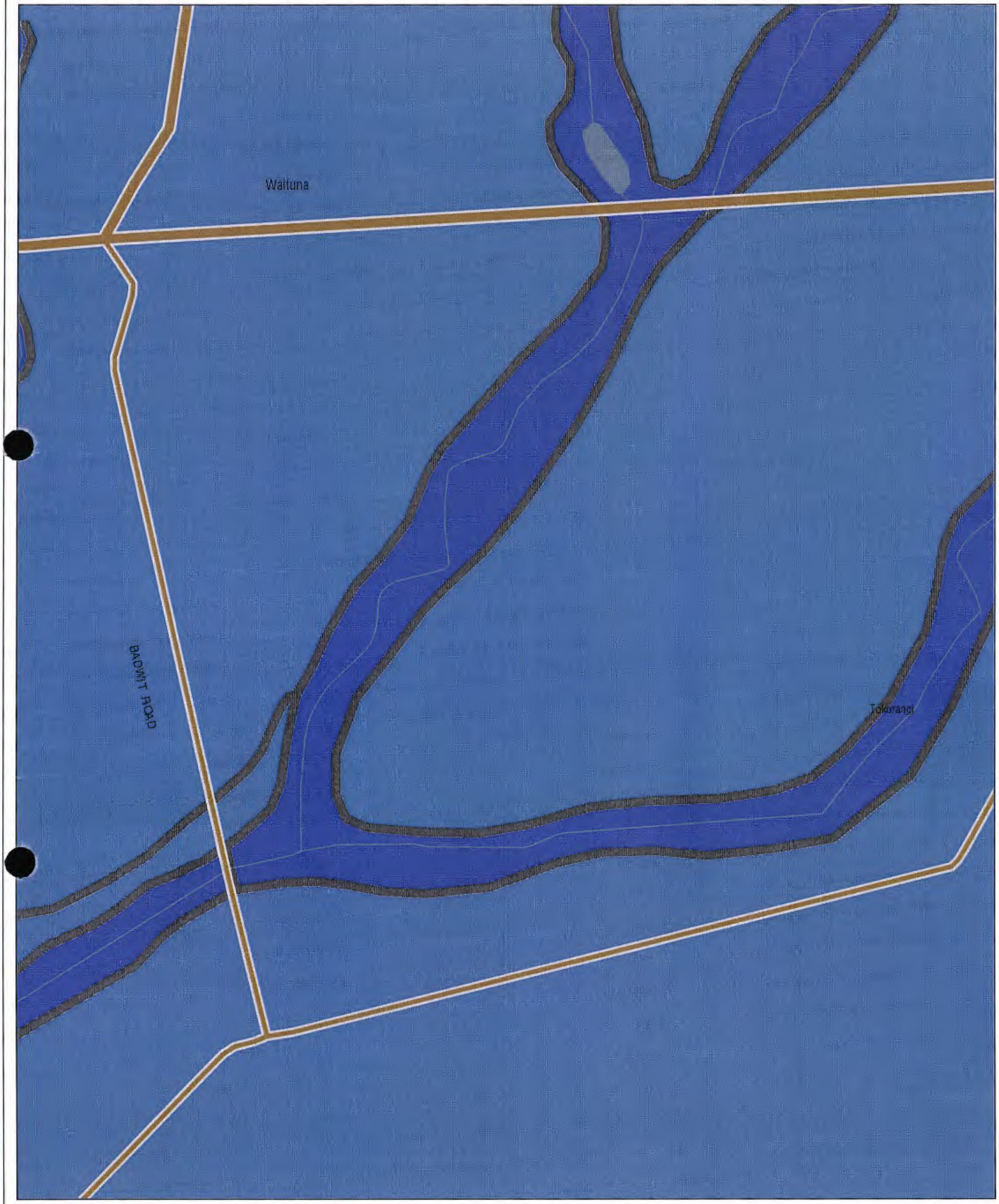
ENGINEERING DESCRIPTIONS							GEOLOGICAL
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
				ψψψψψψ	SILT; organics, dark brown	M	Topsoil
				ψψψψψψ			
				xxoxxoxxo	SILT; Gravelly; very minor clay; friable		Woodlands Soil
			0.4	xxoxxoxxo			
				xxoxxoxxo			
				xoxoxxoxx	SILT; gravelly; gravel sub-rounded to rounded, some cobbles up		Alluvial Gravels
				xoxoxxoxx	to 150 mm; greyish		
			0.8	xoxoxxoxx			
				xoxoxxoxx			
				xoxoxxoxx			
				xoxoxxoxx			
			1.2	xoxoxxoxx			
				xoxoxxoxx			
				xoxoxxoxx			
				xoxoxxoxx			
			1.6	xoxoxxoxx			
				xoxoxxoxx			
				oo-Ooo-oo	GRAVEL; fine to medium; some gravel to 100 mm; some clay; orangey	M/W	
				oo-Ooo-oo			
			2.0	oo-Ooo-oo			
				oo-Ooo-oo			
				oo-Ooo-oo			
				oo-Ooo-oo			
	▼		2.4	oo-Ooo-oo	Evidence of water at 2.4 m		
				oo-Ooo-oo			
				oo-Ooo-oo			
				oo-Ooo-oo			
			2.8	oo-Ooo-oo			
				oo-Ooo-oo			
				oo-Ooo-oo			
				oo-Ooo-oo			
			3.2	oo-Ooo-oo			
				oo-Ooo-oo			
				oo-Ooo-oo			
				oo-Ooo-oo			
			3.6	oo-Ooo-oo			
				oo-Ooo-oo			
				oo-Ooo-oo			
				oo-Ooo-oo	Groundwater entering pit at 3.9 m	W	
			4.0	oo-Ooo-oo			
				oo-Ooo-oo			
				oo-Ooo-oo			
					End of test pit		

OTHER COMMENTS:	Logged By:	DCS
	Checked Date:	10-Feb-15
PHOTO REF.:	Sheet:	1 of 1



SOILS TYPES AND CLASSIFICATONS MAP
not to scale

Schrader #2 Effluent PAW Map



Landcare Research
Manaaki Whenua

Scale: 1:10,000

Printed: 15:40:00 PM Thu, 5 Feb 2015

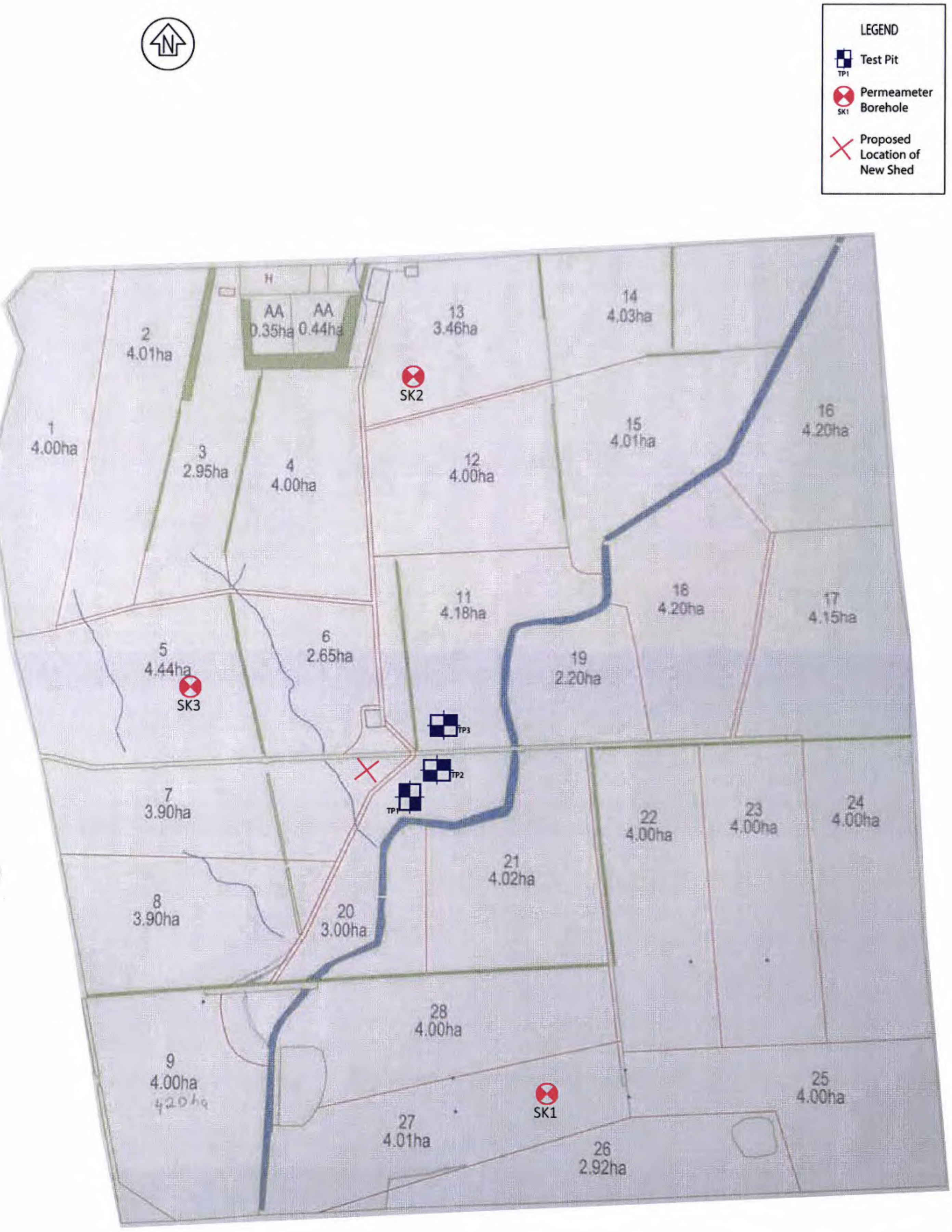
Legend

Soil Moisture - Profile Available Water in 1m (mm)

- 🟦 High
- 🟦 Very High

S-mapOnline
Fast, simple access to New Zealand soils data

Landcare Research
Manaaki Whenua



INVESTIGATION LOCATION PLAN
not to scale

DAritech Ltd
-Dec-2014

Schrader #2 Effluent
50193

Soil name: Dacre

Overview

Dacre soils occupy about 13,200ha on floodplains of minor steams of the Southland plain between the Oreti River and Tokanui. They are formed into fine alluvium from rewashed loess. These soils are moderately deep to deep, poorly drained, and have silty textures. They are used in association with adjacent well drained soils for intensive pastoral farming with sheep, dairy and deer. Climate is cool temperate with regular rain, so soils are often wet.

Dacre profile

Physical properties

Dacre soils have a deep rooting depth and high available soil water, although the rooting depth may be limited by poor aeration during wet periods due to the poor drainage and slow subsoil permeability. Texture is typically silt loam and topsoil clay content is 20–30%. The soils are typically stone free, although the moderately deep phase will have gravels between 45–90cm depth.

Fertility properties

Topsoil organic matter levels are variable and range from 6 to 16%; P-retention values 25–50%; pH values moderate and low in the subsoil. Cation exchange values are moderate, grading to low in the subsoil, while base saturation values are high in the subsoil. Available magnesium and potassium are low, as are soil reserve phosphorus levels. Micro-nutrient levels are generally adequate.

Associated and similar soils

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

- Otanomomo: very poorly drained peat soils
- Otepuni: shallow, poorly drained soil on quartz gravels
- Tisbury: poorly drained gley soil, formed in loess on terraces
- Woodlands: imperfectly drained soil formed in loess on terraces.

Some soils that have similar properties to Dacre soils are:

- Titipua: has over-thickened slightly peaty topsoils
- Jacobstown: has a more developed structure with silty textures
- Caroline: has a cemented ironpan in the subsoil.
- Makarewa: has a clayey subsoil with greater structural development.

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 poor drainage, that is offset by the moderate topsoil organic matter and P-retention levels.
Nutrient leaching	slight	These soils have a slight vulnerability to leaching to groundwater. This rating reflects the high water holding capacity and slow subsoil permeability.
Topsoil erodibility by water	slight	Due to the medium organic matter and clay content, 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	severe	These soils have a severe vulnerability to waterlogging during wet periods. This rating reflects the poor drainage and slow subsoil 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.

DcU1 (Dacre undulating deep)
DcU2 (Dacre undulating moderately deep)

Versatility evaluation for soil DcU1, DcU2		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Limited	Inadequate aeration during wet periods; risk of short-term waterlogging after heavy rain.
Arable	Limited	Inadequate aeration during wet periods; risk of short-term waterlogging after heavy rain.
Intensive pasture	Moderate	Inadequate aeration during wet periods; risk of short-term waterlogging after heavy rain.
Forestry	Limited	Inadequate aeration during wet periods; potential flood risk.

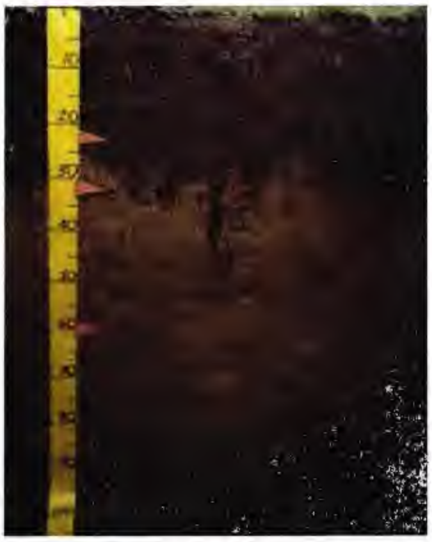
Management practices that may improve soil versatility

- 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 subsurface mole and tile drains will reduce the risk of short-term waterlogging.
- If compaction occurs, aeration at the correct moisture content and depth can be of benefit.

Topoclimate Southland Soil Information Sheet No. **24**

Soil name: Woodlands

Overview



Woodlands profile

Woodlands soils occupy 24,500 ha on intermediate and high terraces of the lower Southland Plain between the Mataura River and Otautau. They are formed in deep wind-deposited loess derived from greywacke and schist rocks. Woodlands soils are imperfectly drained, 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 and receive regular rain over the year and seldom dry out.

Physical properties

Woodlands soils have a deep rooting depth and high plant-available water, meaning there is no major physical barrier to root growth, although high bulk density in the lower subsoil may restrict root penetration. The compact subsoil is slowly permeable, and may cause short-term waterlogging and limit aeration after heavy rainfall. Texture is silt loam in all horizons, with topsoil clay content of 20-30%. Woodlands soils are typically stone free, although the moderately deep phases have gravel between 45 and 90cm depth that may restrict rooting depth and available water to moderately high.

Fertility properties

Topsoil organic matter levels are 5-7%; P-retention values 30-60%; pH values are moderate, with some profiles below 5.5. Cation exchange and base saturation values are moderate and available magnesium and potassium low. Soil reserves of phosphorus are low and available sulphate sulphur high in the subsoil. Micronutrient levels are generally adequate.

Associated and similar soils

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

- Waikiwi: occurs on the same landforms, but is well drained
- Dacre: poorly drained soil on floodplains of streams and minor drainage channels.
- Oteramika: shallow soil occurring on shoulder and side slopes where loess has been eroded away
- Pukemutu: poorly drained soil, due to water perching on a dense subsoil fragipan.

Some soils that have similar properties to Woodlands soils are:

- Mokotua: occurs on the same landforms, but is more severely mottled, with the imperfect drainage tending towards poorly drained. The soils lack the structureless horizon, having a structured subsoil to 90cm.
- Arthurton: imperfectly drained Brown soil associated with Pallic soils of northern Southland, reflected in P-retentions of 20-40%
- Aparima: imperfectly drained Brown soil with a fragipan, associated with Pallic soils (Pukemutu series) on the Southland Plains, west of the Oreti River
- Fortrose: imperfectly drained soil occurring in near-source loess east of the Mataura River, west to south of Fortrose; has pale coloured subsoils with loamy silt textures.

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 moderate topsoil clay and P-retention values, but is offset by the imperfect drainage.
Nutrient leaching	slight	These soils have a slight vulnerability to leaching to groundwater. This rating reflects the imperfect drainage, high water holding capacity and slow subsoil permeability .
Topsoil erodibility by water	slight	Due to the topsoil clay percentage, the topsoil erodibility 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 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.

WdU1 (Woodlands undulating deep); WdU2 (Woodlands undulating moderately deep)

Versatility evaluation for soil WdU1, WdU2		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Moderate	Inadequate aeration during wet periods; risk of short-term waterlogging after heavy rain.
Arable	Moderate	Inadequate aeration during wet periods; risk of short-term waterlogging after heavy rain.
Intensive pasture	Moderate	Inadequate aeration during wet periods; risk of short-term waterlogging after heavy rain.
Forestry	Moderate	Vulnerability to sustained waterlogging.

WdR1 (Woodlands rolling deep); WdR2 (Woodlands rolling moderately deep)

Versatility evaluation for soil WdR1, WdR2		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Moderate	Inadequate aeration during wet periods; rolling slopes
Arable	Limited	Rolling slopes.
Intensive pasture	Moderate	Inadequate aeration during wet periods; rolling slopes.
Forestry	Moderate	Vulnerability to sustained waterlogging.

WdH1 (Woodlands hilly deep); WdH2 (Woodlands hilly moderately deep)

Versatility evaluation for soil WdH1, WdH2		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Unsuitable	Hilly slopes
Arable	Unsuitable	Hilly slopes
Intensive pasture	Limited	Hilly slopes
Forestry	Moderate	Vulnerability to sustained waterlogging; hilly slopes.

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 content can be of benefit.

APPENDIX D. DESIGN DRAWINGS

1. Deferred Storage Pond Drawings

Revision History

rev	date	issue
01	04/02/2015	RESOURCE CONSENT

Notes:

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3. Cut / Fill volumes solid measure, approximate only, and based on typical pond section. Contractor to confirm volumes.
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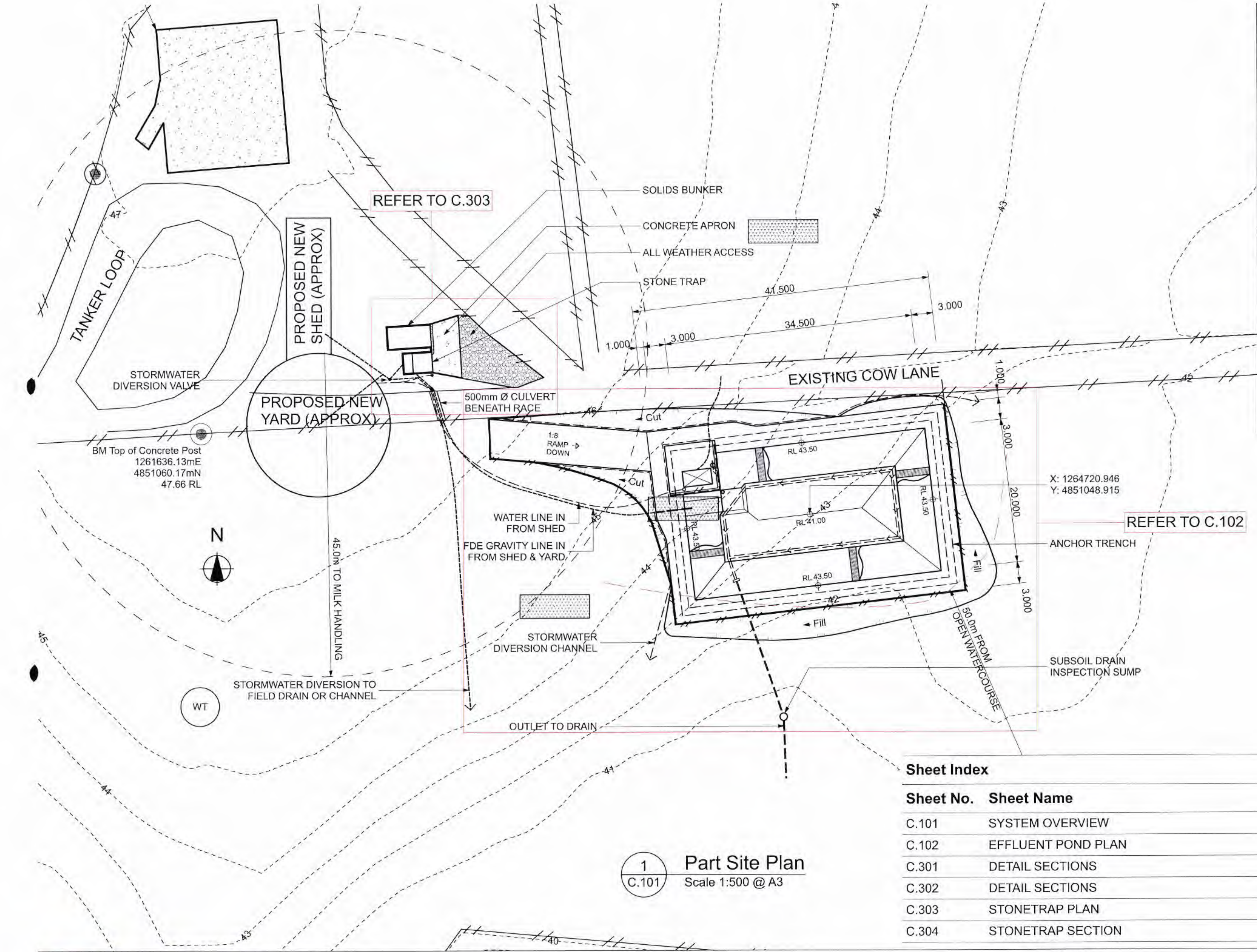
14. All excavation work to comply with health and safety requirements for working in trenches and pits and the specific site hazards.
15. Safety Bouys to have min 30.0m rope length and to be mounted on Fence Post.



Part Site Plan

1
C.101
Scale 1:500 @ A3

Sheet Index

Sheet No.	Sheet Name	Published	Rev No.
C.101	SYSTEM OVERVIEW	☒	01
C.102	EFFLUENT POND PLAN	☒	01
C.301	DETAIL SECTIONS	☒	01
C.302	DETAIL SECTIONS	☒	01
C.303	STONETRAP PLAN	☒	01
C.304	STONETRAP SECTION	☒	01

RDAgritech
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Engineering Firm
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Project Manager

Client
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514 RIMU SEAWARD DOWNS ROAD
OTERAMIKA

SCHRADER #2
EFFLUENT POND
DESIGN

Sheet Title:
SYSTEM OVERVIEW

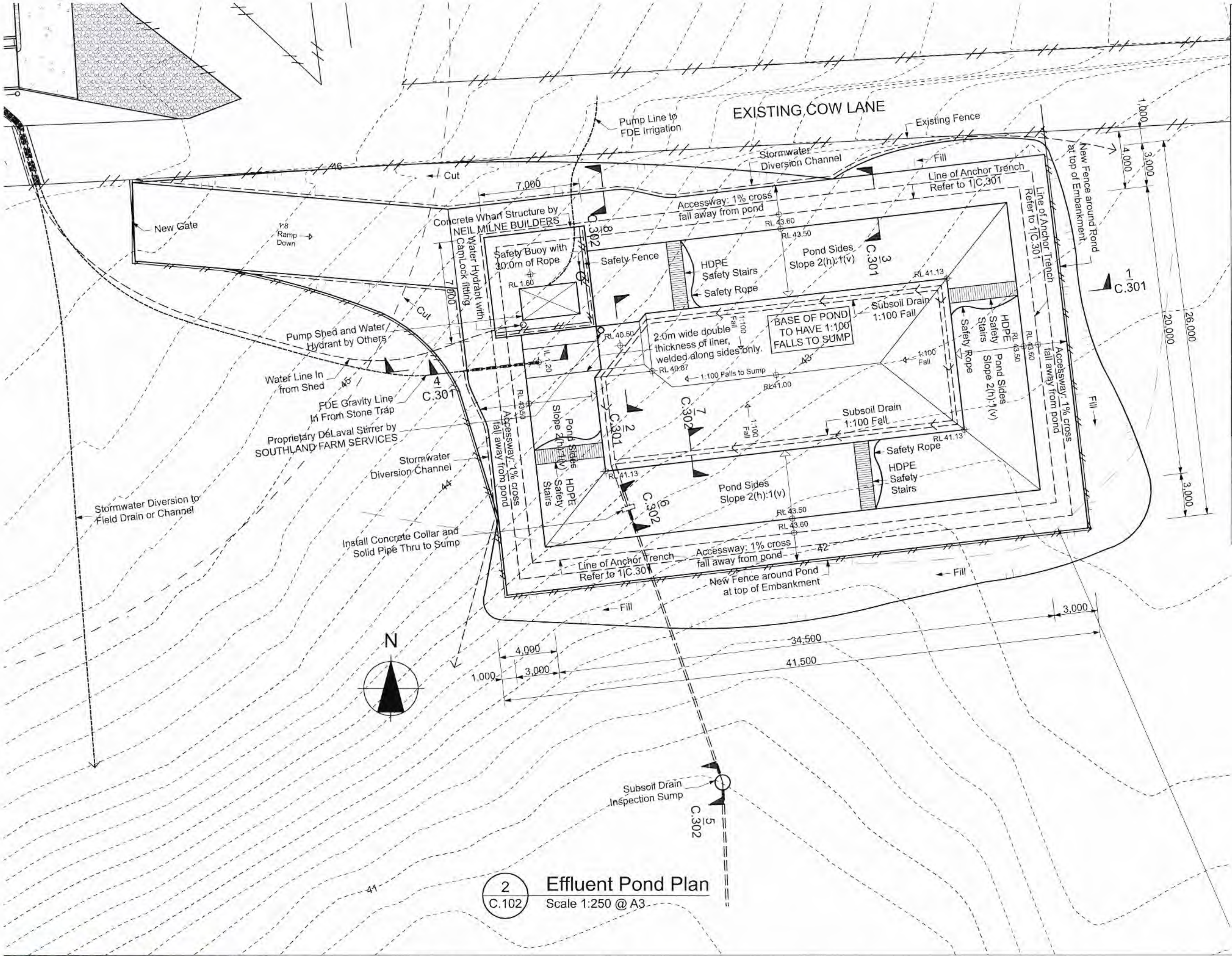
Printed: 4/02/15

Scale:
as shown

Job No.
50193

Drawing No.
C.101

Revision
01



2 C.102 Effluent Pond Plan

Scale 1:250 @ A3

Revision History

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01	04/02/2015	RESOURCE CONSENT

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KEY:

- - - - - - - Existing Contours

Solid Measures (Approximate)

Topsoil Strip:	585m^3
Cut:	290m^3
Fill:	495m^3
Borrow to Fill:	205m^3

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SCHRADER #2
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Sheet Title:
EFFLUENT POND PLAN

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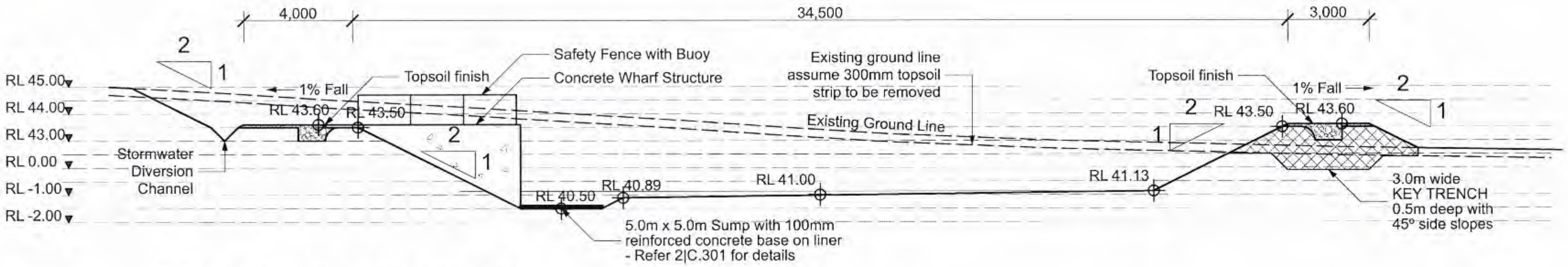
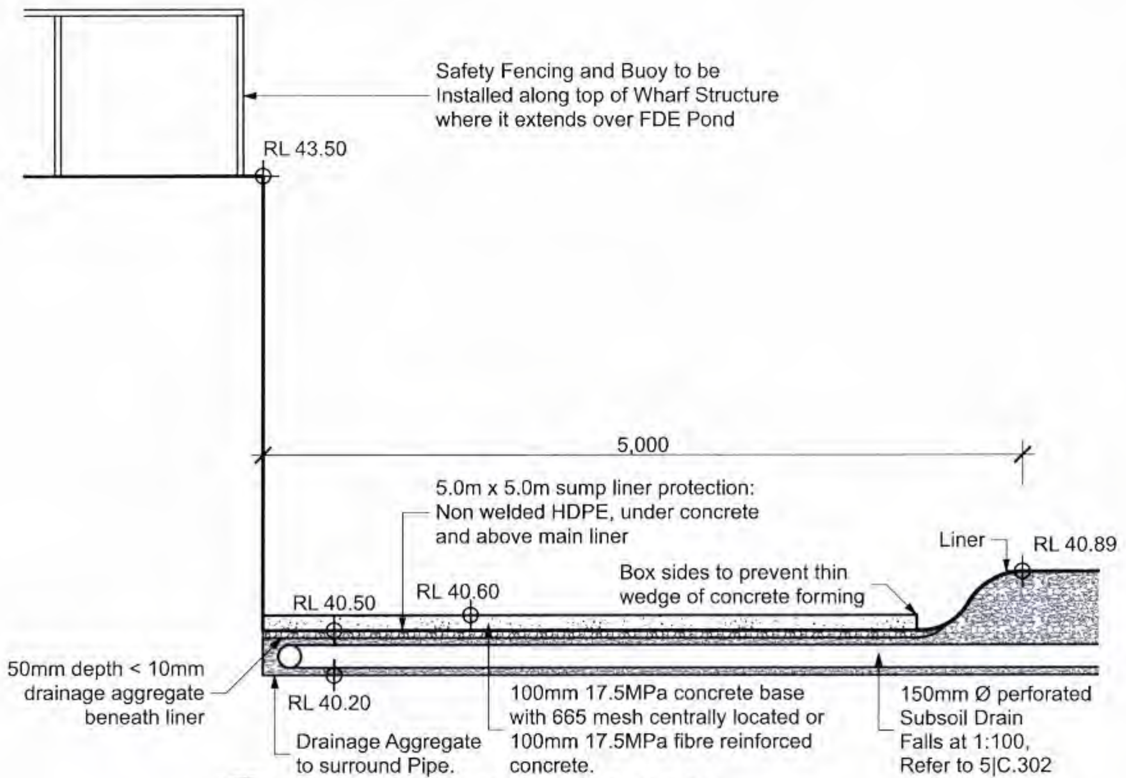
Scale: as shown
Drawing No. C.102
Job No. 50193
Revision 01



1 | C.102

TYPICAL POND SECTION

Scale 1:200 @ A3



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PUMP SUMP SECTION

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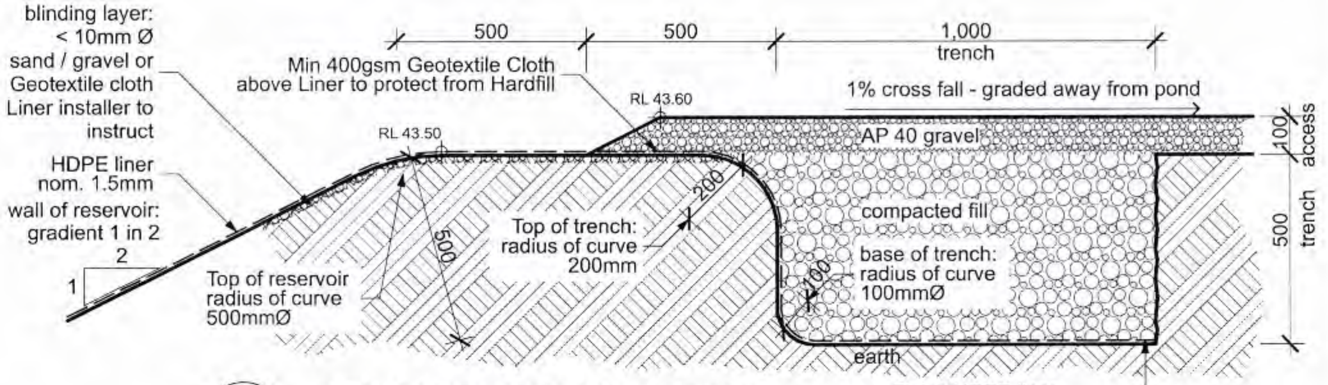

3 | C.102

ANCHOR TRENCH DETAIL

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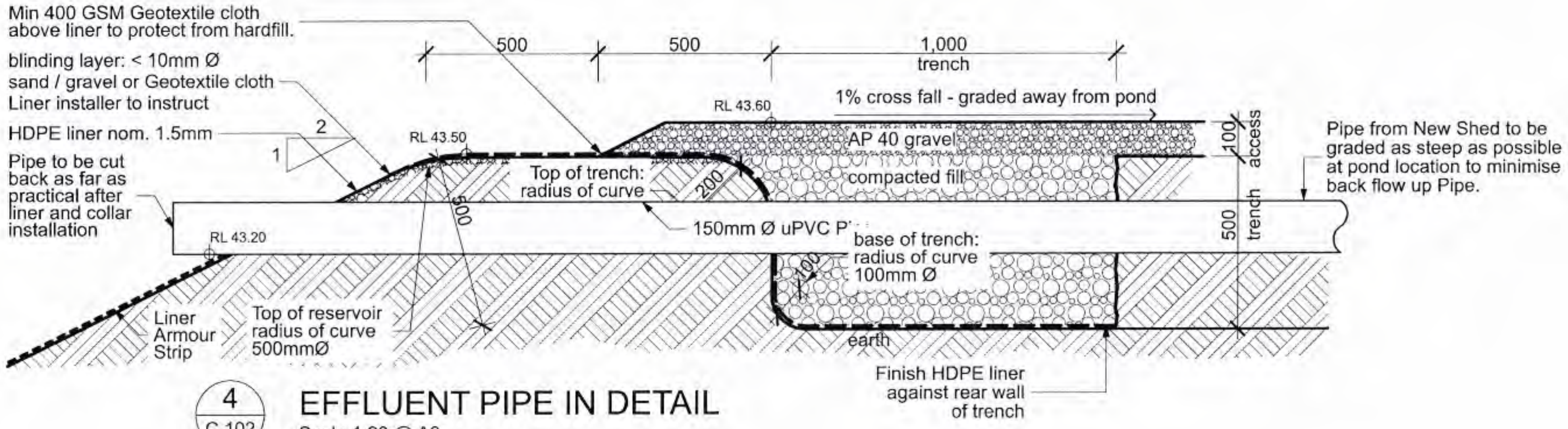

4 | C.102

EFFLUENT PIPE IN DETAIL

Scale 1:20 @ A3

Revision History

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01	04/02/2015	RESOURCE CONSENT

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SCHRADER #2
EFFLUENT POND
DESIGN

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DETAIL SECTIONS

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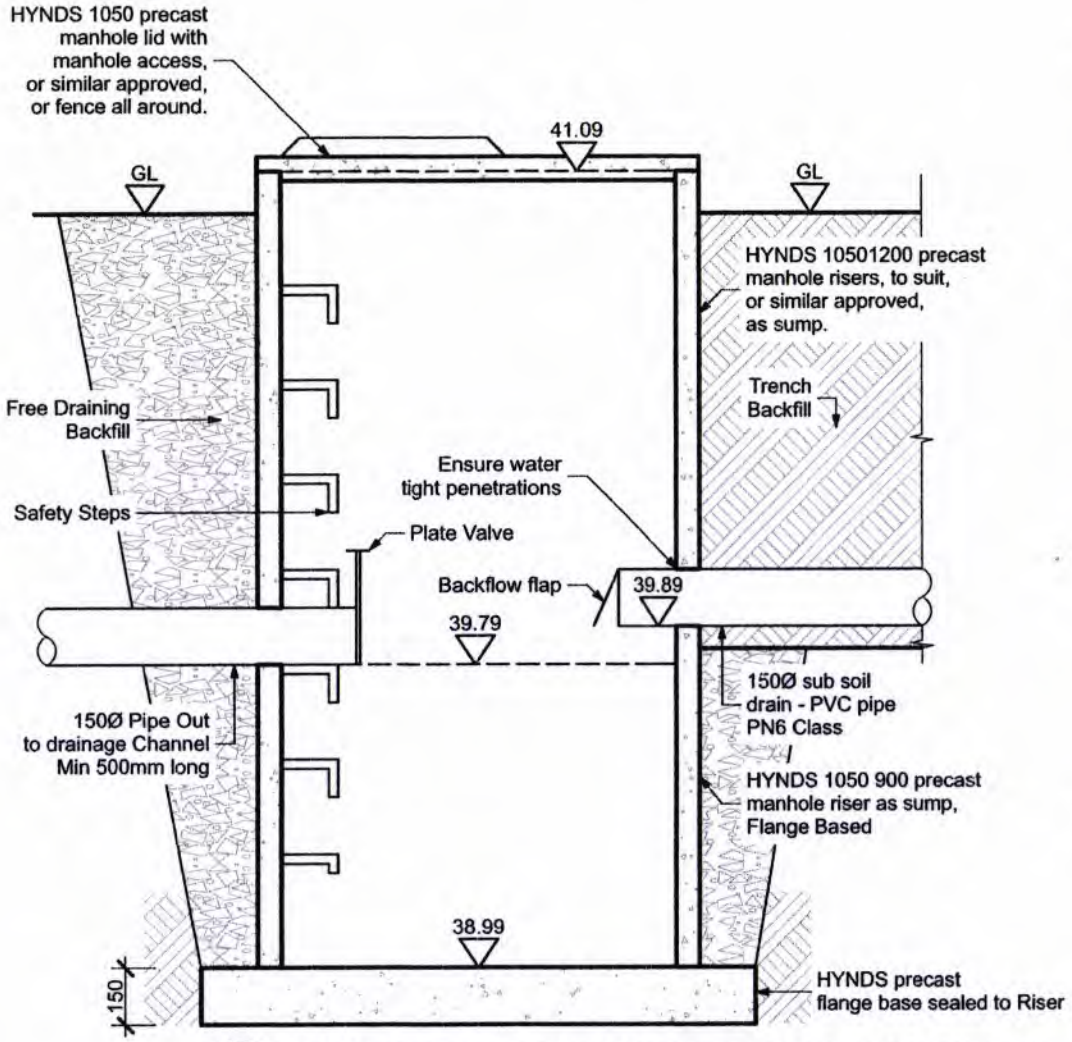
Job No.
50193

Drawing No.
C.301

Revision
01



5
C.102

SUBSOIL DRAIN INSPECTION SUMP DETAIL

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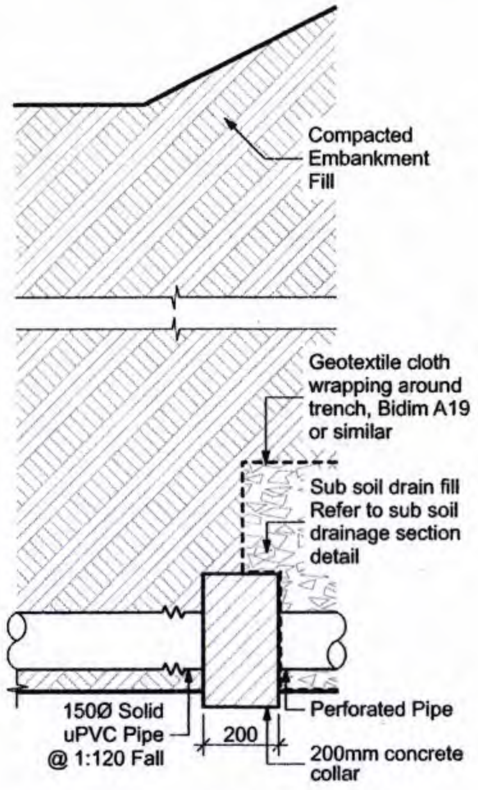

6
C.102

SUBSOIL DRAIN
PIPE TRANSITION DETAIL

Scale 1:20 @ A3

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01	04/02/2015	RESOURCE CONSENT

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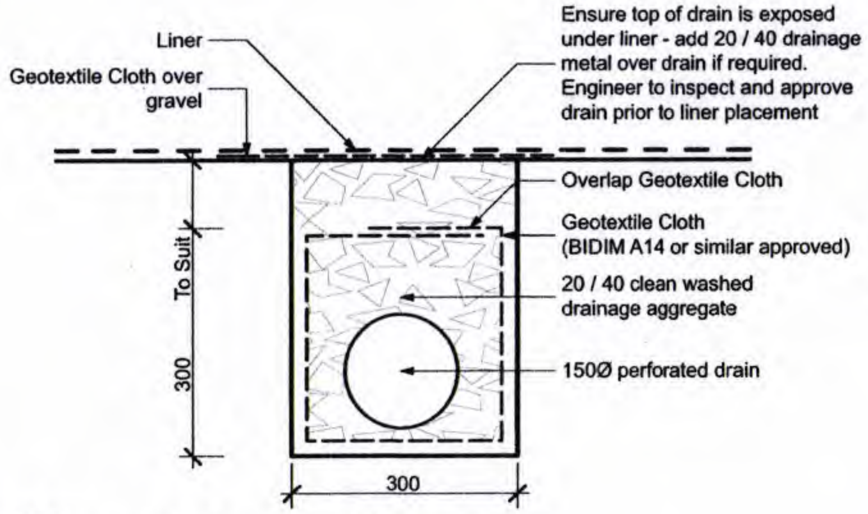

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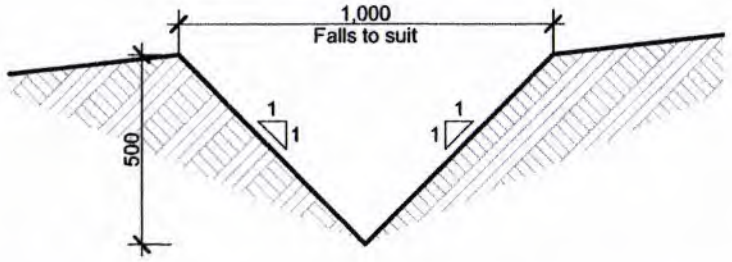
C.102

SUBSOIL DRAIN SECTION

Scale 1:10 @ A3



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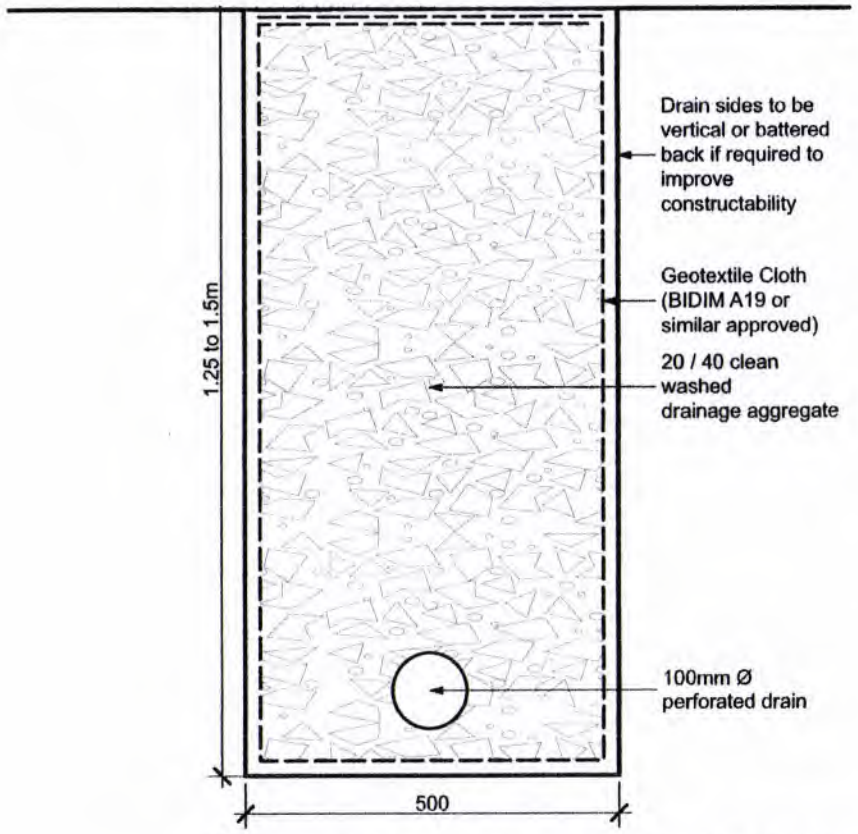
C.102

STORMWATER DIVERSION CHANNEL

Scale 1:20 @ A3



10

COUNTERFORT DRAIN SECTION

Scale 1:10 @ A3

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SCHRADER #2
EFFLUENT POND
DESIGN

Sheet Title:
DETAIL SECTIONS

Printed: 4/02/15

Scale:
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Job No.
50193

Drawing No.
C.302

Revision
01

Revision History

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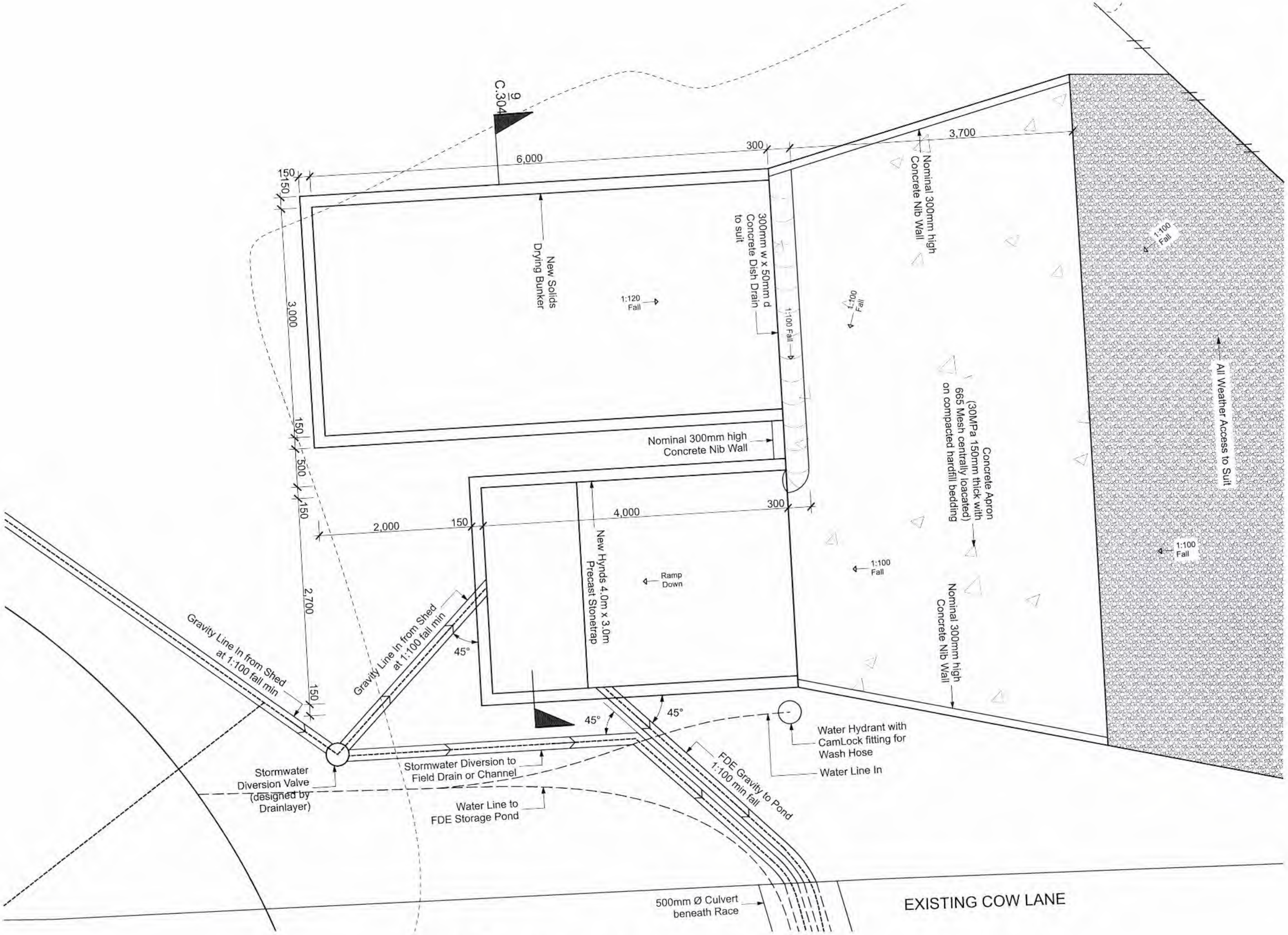

3
C.303

Stonetrap Plan

1:50 @ A3

RDAgritech ENGINEERED BY NATURE	Engineering Firm RDAgritech Ltd P.O. Box 1711 Invercargill 9840	Project Manager	Client SCHRADER MAINS LTD 514 RIMU SEAWARD DOWNS ROAD OTERAMIKA	SCHRADER #2 EFFLUENT POND DESIGN	Sheet Title: STONETRAP PLAN Printed: 4/02/15	Scale: as shown Job No. 50193	Drawing No. C.303 Revision 01

Revision History

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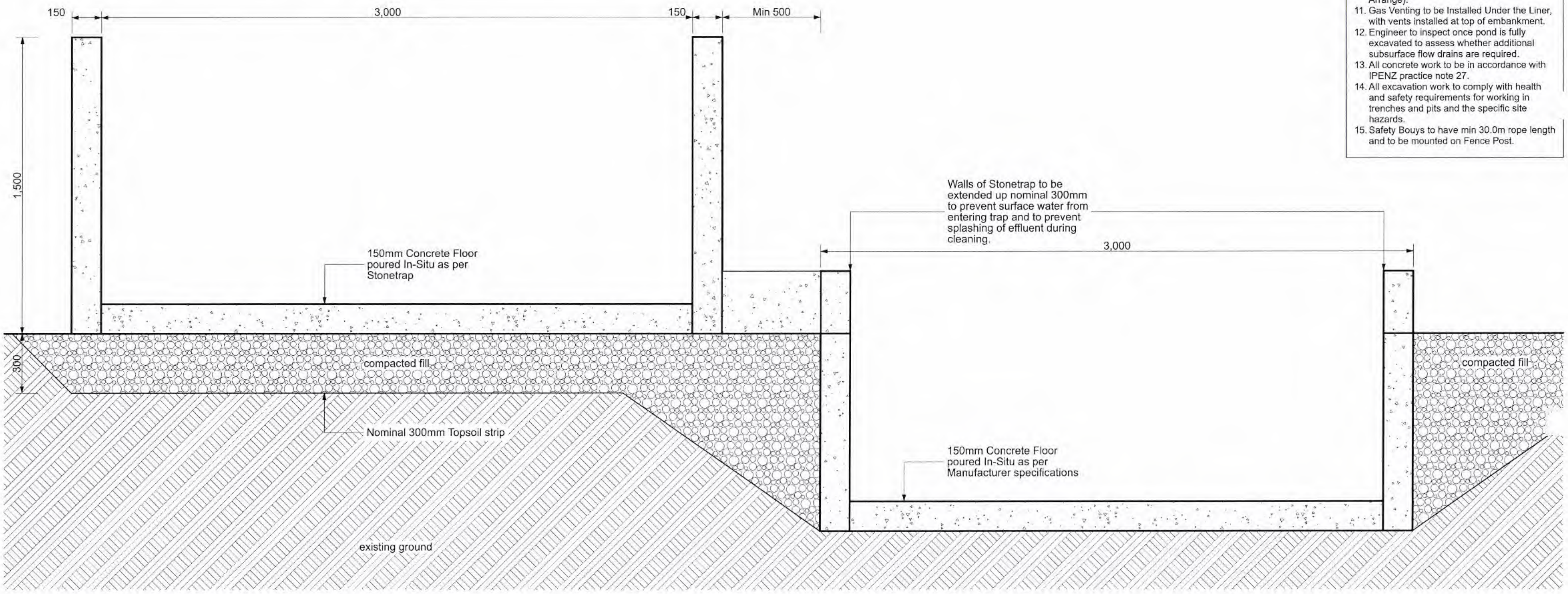

9
C.303

STONETRAP / SOLIDS BUNKER SECTION

Scale 1:20 @ A3

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SCHRADER #2
EFFLUENT POND
DESIGN

Sheet Title:
STONETRAP SECTION

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Job No.
50193

Drawing No.
C.304

Revision
01

APPENDIX E. SPECIFICATIONS

1. Earthfill Specification

SCHRADER #2 EARTHWORKS AND EARTHFILL SPECIFICATION

1 SCOPE

This specification consists of the excavation and bulk earth fill requirements for the site including the stripping of topsoil, controlled filling, cut to waste, topsoiling and re-vegetation, excavation of open drains and other related work for the placement of bulk earth fill. This Specification shall be read in conjunction with all other documents.

The specification will form the basis of works to enable the Pond to be certified in accordance with the Environment Southland Land use consent issued for the works.

All works shall be in accordance with the issued consent documents for the property, design drawings, specifications and any other documents or variations issued as part of the works to be completed.

2 RELATED DOCUMENTS

In this Specification, reference is made to the following documents:

- New Zealand Building Code
- NZS 4431:1989 Code of practice for earthfill for residential development
- NZS 4402: 1986 Methods of testing of soils for civil engineering purposes (Suite)

3 QUALITY ASSURANCE

The work shall be carried out by a reputable Earthworks Contractor, in accordance with best trade practice of sound repute by competent craftsmen using equipment, materials and processes that are best suited for the purpose and shall be of the very highest standard.

No Change or Variation is permitted unless the Engineer provides appropriate written instructions.

Dimensions and details shall be read in conjunction with the Engineer's drawings. The Contractor shall check all dimensions before construction commences.

The Contractor shall fully comply with all the provisions of the New Zealand Building Code, including all requirements for site and worker safety.

Ensure that all contract insurances are in place before starting work on site. Insurances shall remain in place for the full duration of the project until practical completion.

Any additional permits, consents or notifications required by any authorities shall be obtained and paid for and all necessary deposits, plans and specifications lodged as required before any work is commenced.

Any tests and inspections required by any of the above regulations or authorities shall be made at the appropriate time. Any works covered up before such required tests or inspections have been made shall be uncovered and opened up for testing and inspection at the Contractor's expense.

4 GENERAL REQUIREMENTS

4.1 DRAINAGE AND EROSION CONTROL

All bulk Earthworks shall be carried out in fully drained conditions with no free water on the working surfaces. Where it is impractical to maintain excavations of unsuitable material deposits in a fully drained condition, the Engineer will have discretion to relax this requirement to the degree that is necessary.

Cut areas shall be sloped and graded adequately so that they do not pond water or allow water to infiltrate, and drains shall be installed or pumping carried out as necessary on a regular basis to remove water from the areas of operations, or to drain water as soon as it is seen to develop.

Any filling, which has been allowed to become too wet or soft, shall be removed and dried, or replaced. All fill surfaces shall be rolled off at the end of each day's work to prevent erosion. Prior to commencement of the filling operations the following day, the smooth surface shall be scarified by approved plant to ensure a good bind to the lower surface is achieved.

4.2 DUST CONTROL

Earthmoving shall be carried out and maintained so that dust is not raised near or blown over the working area and existing buildings. The Site shall be kept watered as necessary to meet this requirement until covered by dust-free materials.

4.3 SILT CONTROL

The Contractor is responsible for all silt control and discharge from the site of works. Silt control measures installed must not allow untreated sediment laden water to enter waterways downstream. The engineer has the discretion to order cessation of works to remedy any non-compliance or what the engineer considers inadequate silt control measures.

As a minimum

- Upslope stormwater diversion channels shall be installed around the fill areas to suit
- Silt fences and hay bales at regular intervals as required to prevent uncontrolled discharge of sediment laden water to the surrounding area.

Ideally a sediment collection pond and decanting pipework would be installed to provided appropriate detention times for suspended sediments, guidance can be found in Auckland Regional Council Technical Publication TP90 here:

http://www.aucklandcouncil.govt.nz/EN/planspoliciesprojects/reports/technicalpublications/Pages/technicalpublications51-100.aspx

4.4 SEQUENCE OF OPERATION

In the event that a particular sequence of operation is required by the Principal or the Engineer, or because of the nature of the Works, then the Contractor shall submit with their original programme, a Methodology Statement that will include their preferred sequence of carrying out the Works. Any such statement shall be subject to the approval of the Engineer and shall comply with any internal completion dates or order of carrying out the Works set out in the contract. The Methodology Statement shall be updated from time to time as required by the Engineer.

4.5 PRESERVATION AND MAINTENANCE

The Contractor shall preserve and maintain all Earthworks, including partly completed Earthworks, and make good at no cost to the Principal any Earthworks that have deteriorated below the specified standards for whatever reason.

4.6 TOLERANCES

All Earthworks shall be carried out to the lines levels and grades shown on the Drawings and specifications. Finished level tolerances shall be as follows:

– Batters	±0 mm to 100 mm
– Other surfaces	±0 mm to 50 mm
– Pipe inverts	±0 mm to 10 mm

5 REMOVAL OF VEGETATION

The Contractor shall remove all vegetation from the site of Earthworks, and shall clear all obstructions from the Site of the Works. Clearing shall mean the removal of all growth (other than grass and weeds), extraction of stumps, and other items remaining above the surface of the ground, and the complete disposal of all items. Extraction of stumps (if any) shall remove all roots greater than 25mm diameter. The removal of grass and weeds shall be provided for under topsoil stripping.

6 EXCAVATION

6.1 REMOVAL OF TOPSOIL

All turf and organic topsoil shall be stripped from the areas subject to Earthworks before other operations commence in these areas. All topsoil shall be stockpiled for future reuse in the locations shown on the drawings or areas otherwise approved on Site by the Engineer or principle. If stockpiled slopes shall not be steeper than 1 vertical to 1.5 horizontal and have all changes of grade rounded to conform generally to the surrounding landscape.

The stockpile should be track rolled during formation as with the outer surface, to minimise organic decay during stockpiling. The location of the stockpile shall be such that no water can pond or be impounded by the stockpile.

The depth of topsoil stripping shall be sufficient to remove all organic material, turf and significant plant roots. Except where limited by boundaries, existing works or other limiting features, stripping shall extend 3 metres beyond the limits of areas subject to Earthworks or construction. The Contractor shall cooperate with the Engineer ahead of and during stripping operations to determine the stripping depth and shall avoid unnecessary over excavation.

6.2 OVER EXCAVATION

The Contractor shall direct their operations to avoid excavating beyond designated profiles. Any excavation beyond these profiles carried out without express instruction by the Engineer shall be made good to the direction of the Engineer with compacted fill of equal quality to that designated to cover the excavated profile. This reinstatement work shall be at no cost to the Principal.

6.3 CUT TO WASTE

All cut material other than topsoil and that required for fill or backfill shall be carted to the Principal's nominated dump or removed from Site and disposed of. The dumped material shall be track rolled and levelled to the level of the surrounding ground or as directed. Any material to be carted offsite will need the principles approval prior to commencing.

6.4 EXCAVATE TO FILL

The location of the borrow area at this stage is the main excavation area as shown on the supplied earthworks drawings. Should this need to be varied it is to be determined during discussions with the successful Contractor and principle. The Engineer or Principle shall advise other areas as required. At this stage any shortfall is expected to be obtained from the existing gravel extraction area previously consented.

The Contractor shall exclude all organic matter from fill excavations.

7 UNDER DRAINS

Under drainage will be required under the sump base of the pond and will be trenched downhill at a minimum grade of 1 in 100. It will be day lighted at an approved sump/wing wall and be protected from stock damage. A drain and sump detail is provided in the design report drawings.

The underdrain beneath the sump is to be perforated drain coil and then connected to a solid uPVC pipe with a concrete collar as per the drawings.

The drainage aggregate must be clean washed, well-graded gravels. TNZ F6 is a suitable drainage material. The entire drainage trench is to be wrapped with geotextile cloth. Engineering approval must be sought prior to any substitutions.

8 INSPECTION SCHEDULE

The following inspection schedule is the MINIMUM number of inspections required. Failure of the contractor to give sufficient notice (48 hours) or covering of works prior to inspection will result in any and all costs to test or inspect the works to the sole satisfaction of the engineer to be born by the contractor.

A schedule of inspection check sheet is supplied with the tender documents and a summary list is detailed below.

- Inspection by the engineer is required post topsoil stripping to confirm adequate removal of organics and topsoil.
- All subgrade areas must be inspected, tested and approved by the engineer or their representative prior to fill placement.
- All under runners shall be subject to engineers' inspection and approved mitigation.
- The engineer will inspect the works during construction to confirm compliance with the drawings and specification as required, with at least 5 visits during construction.
- in-situ density testing in accordance with section 9.3 test 4B (NDM) below would be conducted by Central Testing Laboratories, or their local agent with Central Testing used for any laboratory testing required, the results will need to be forwarded to RDAgritech within 24 hours of results being available or a verbal call as a minimum.
- in-situ density testing in accordance with section 10.0 below would be conducted by RDAgritech Ltd, with central testing used for any laboratory and a subcontracted company for NDM testing if required would be specified by RDAgritech Ltd.

9 FILL PLACEMENT

9.1 GENERAL

Prior to compaction, all fill material shall be broken into fragments of less than 200mm. The material shall be spread uniformly in layers of less than 200mm thickness, and conditioned to appropriate average water content.

New fill shall not be spread over surfaces that have deteriorated from their specified condition. Where necessary, the old surface shall be scarified, conditioned, re-compacted and retested before placing new fill.

The Contractor shall exclude all organic matter from fills.

Where the fill surface has been subject to freezing then no fill shall be placed until the surface has adequately thawed and the surface reconditioned to acceptable for fill placement.

Fill placed in the anchor liner trench needs to be compacted carefully to the following standards due to the risk of liner puncture.

All fill batters will be overfilled and then cut back to the final shape. Compaction shall not occur on sloping surfaces.

9.2 EQUIPMENT

The Contractor shall employ sufficient compaction equipment to achieve the specified compaction. The number and type of plant necessary shall be confirmed by trials. No subsequent changes shall be introduced without the prior approval of the Engineer.

9.3 CONTROL OF WATER CONTENT

When soil is to be dried the Contractor shall disc the soil and allow it to dry uniformly to its full depth. Alternative other dry soils may be mixed to a uniform consistency to help with the reduction of water content on the whole.

When the soil is to be wetted, this shall be done with sprinkling equipment ensuring uniform and controlled distribution of water in conjunction with blading and discing.

Any costs of drying or wetting will be deemed to be included in the fill rate or other scheduled items. No extra payments will be made.

9.4 COMPACTION REQUIREMENTS

The maximum dry density will be determined by the methods of NZS: 4402 where these are appropriate.

The compaction requirements for embankment fill material shall be as follows:

- Cohesive material such as bulk fill to the finished levels sourced from the excavation or borrow pit (Silts/Clays etc.) shall be placed in uniform layers not greater than 200mm loose thickness. Fill shall achieve the following standards:
  - The in-situ dry density shall be not less than 95% of the maximum dry density (MDD), and/or
  - Average vane strength over 10 consecutive readings shall not be less than 100kPa with no individual reading less than 80kPa.
  - For onsite correlative testing the Scala Penetration Resistance SPR (number of blows to drive the Scala penetrometer 150 mm) below the fill surface shall be not less than 8. The upper 150 mm may be ignored for the purpose of this test. This is to be recorded by adding the blows per 50 mm for a consecutive 150 mm depth with the SPR for each 50mm the addition of the preceding three 50mm intervals. Ideally the target depth would be 900mm for each test point.
- Cohesionless material such as onsite or imported gravels, sands and hard fill shall be placed in uniform layers not greater than 200mm loose thickness. Compaction on each layer of fill materials so placed shall be sufficient to obtain the following standards:
  - The SPR will be a minimum of 12, or
  - The in-situ dry density shall be not less than 95% of the maximum dry density (MDD), and
  - No undue deflection occurs when tracked with a fully loaded 6-wheel dump truck.

The base of the excavation shall also be compacted/conditioned to achieve an SPR minimum of 8 or in-situ shear vane of 100kPa.

9.5 COMPACTION TRIALS

Before filling is started the Contractor shall demonstrate to the Engineer the adequacy of the equipment to be used by spreading and compacting a minimum of three individual superimposed layers of soil (200mm thickness before compaction) in which tests of the standard of compaction shall be conducted.

The required standards of compaction shall be as defined in Clause 9.4. During the compaction trials the Contractor may develop, in conjunction with the Engineer, ad hoc tests, which the Contractor may use himself as an approximate guide to the standard of compaction being achieved at any time.

Should differing kinds of soil be uncovered during the course of subsequent work, further trials shall be conducted at the direction of the Engineer.

At the time of writing the specific fill borrow was not known, when the Contractor is made aware of the area then compaction samples should be taken and sent to the lab for processing, this usually takes 7 days for a result so preplanning is essential.

10 TESTING

10.1 GENERAL

Were a subcontracted testing agency for onsite NDMs is engaged, the Contractor will be responsible for coordinating and paying for all testing of the fill to meet the requirements of the specification. The results of which will be forwarded to the Engineer daily.

The Engineer or testing agency (Inspector) may carry out check tests of compaction at any time. The Contractor shall stop or divert their machines as required by the inspector to allow the tests to be carried out.

Where field tests indicate that the specified standard of compaction has not been achieved, the inspector may order cessation of work and/or removal of the fill, subject to the nature of the fill concerned.

All costs associated with the re-testing of any fill areas that fail to meet the specified standards, will be charged to the Contractor and will be deducted from Progress Payments.

Such costs will include all related supervision and administration time incurred by the Inspector or Engineer and their staff in determining the extent of compacted fill failing to meet the specified standards, its subsequent re-testing and the effecting of the appropriate advice to all parties concerned.

At any time either prior to or during the course of construction, the Inspector may direct modifications to the compaction methods, with the object of ensuring that the optimum compaction criteria for the particular materials and conditions being encountered or likely to be encountered are achieved.

Where no compaction curves are available in the specification or reporting, or the Contractor feels he does not have sufficient information within the pond extents to successfully complete the contract, it is the Contractor's responsibility to notify the Engineer as well as conducting their own investigation of the pond area and obtaining appropriate compaction samples or additional information as they deem necessary.

10.2 TESTING PROCEDURE

The Contractor shall be responsible for ensuring that the specified compaction parameters are achieved and shall carry out such testing as is needed to ensure the consistent quality of the fill. Approximate test methods may be employed to obtain rapid indicative results, but approximate methods shall not be used for acceptance purposes where the adequacy of materials, processing or workmanship is in doubt or the amount by which the test result fails, falls within the confidence limits of the approximate test result.

The tests described and defined in Clause 10.3 will be used to determine the classification and compaction standards of fill materials.

The Contractor shall interrupt or divert their operations as necessary to permit the Inspector to conduct any verification tests required with complete safety.

10.3 TESTS AND TEST METHODS

Test No.	Test	Test Method
2	Vane Shear*	Test Method for Determining the Vane Shear Strength of a Cohesive Soil using a Hand Held Shear Vane, NZ Geotechnical Society, 2001
3	Sieve Analysis	NZS 4402:1980 (Test 2.98.2)
4A	In-situ Density*	ASTM D2922 (& D3017) (Nuclear Densometer) may be used
4B	Water Content	NZS 4402:1986 Test 2.1
4C	Solid Density	NZS 4402:1986 Test 2.7
6	Scala Penetrometer	NZS 4402:1988 Test 6.5.2

* Test method qualified by following notes.

Vane Shear Tests:

The vane shear strength of the soil at any test position shall be taken as the mean of the results of a set of tests. A set of shear tests shall comprise four or more individual tests made within an area of 1m2.

- Before a new shear vane is first used it should be calibrated to obtain values of torque vs. spring deflection. It should be recalibrated at intervals of not more than 12 months.
- The vane shear strength of the soil must be derived in accordance with the Test Method for Determining the Vane Shear Strength of a Cohesive Soil using a Hand Held Shear Vane New Zealand Geotechnical Society 2001.
- Vane shear strengths based on vane manufacturer's empirical calibrations shall not be used.
- During penetration or testing with the shear vane, every effort shall be made to avoid any gravels present in the fill. If it can be demonstrated that any single test is influenced by the presence of gravels, that single test shall be noted but the result disregarded for acceptance purposes.

10.4 TEST FREQUENCY

The frequency of testing will depend on the consistency of fill operations and materials used, but the testing rate will be generally as follows:

Test	Location/purpose	Frequency
In-situ density	Bulk fill and lining materials	1 set per 250 m^3 or every 0.5 m lift for the first 1.5 m lift, then as required by the engineer.
Water content	In-situ density air voids	As per in-situ density
Solid density	For use in measuring air voids	One per soil type
Shear Vane	Shear strength	As required
Scala Penetrometer	Soil strength	As required

As soon as the Engineer is satisfied that materials are consistent and work is being carried out in a systematic and consistent manner, they may reduce the frequency of testing as they judge to be appropriate.

11 TOPSOILING AND GRASSING

11.1 GENERAL

Topsoil shall not be handled or worked when plastic (mouldable), unless directed by the Engineer. Where it is necessary to place the topsoil when plastic, the soil shall be loosely deposited across the site, and then allowed to dry before being worked. All traffic shall be kept off the topsoil when plastic.

Unless otherwise instructed, the Contractor shall use the stockpiled material removed during site preparation. Should there be a shortage of stockpiled materials, the Contractor shall obtain the approval of the Engineer and principle for the importation of topsoil from sources external to the Site. Such imported topsoil shall be clean friable soil, free from excessive amounts of sand, gravel and stones, and shall be capable of supporting the vegetation specified.

Topsoil shall be spread over all areas to be revegetated to a minimum thickness of 200mm. Spreading shall not be done when the ground or the topsoil is excessively wet or otherwise in a condition detrimental to the work.

Should excess soil be available it may be used on the outside of the embankments as buttress and to reduce the slope of the external batters. The soil should be shaped to conform with natural contours and be as smooth as possible with a gentle transition.

All topsoil shall be smoothed with a chain harrow towed by a light tractor or similar to eliminate all minor depressions and wheel marks and to produce a smooth evenly graded open textured surface that will not hold water.

The seed and fertiliser shall be uniformly distributed and harrowed into the topsoil to a depth of 15 - 20mm, leaving a smooth, evenly graded, open textured surface which will not hold water. The Contractor shall not compact the topsoiled surface.

The Contractor shall maintain, dress up and re-sow as necessary, the topsoiled and revegetated surfaces until all surfaces are completely covered with a good strike of revegetation and free from runnels.

The Principle shall specify and supply the pasture type and mix.

11.2 MARGINAL AREAS

Marginal areas between roads, security fences and buildings shall be covered with not less than 100mm of topsoil, and sown and fertilised with a grass seed and fertiliser mix suited to the soil and climate of the District or as specified.

12 SYNTHETIC LINER

The synthetic liner proposed is a 1.5 mm HDPE. Alternative liner systems will require approval from RDAgritech Ltd.

The licensed installer of the product will undertake all installation requirements for placement in accordance with the design/build components supplied by them. All instructions and requirements for them to provide their 20 year warranty must be complied with. Liner installers have advised that the liner is to be placed on a sand, or less than 10mm gravel, blinding layer of 20 mm thickness or a geotextile cloth protection layer. All batter edges and corners are to have a minimum 0.5 m radius rounded edge to prevent liner damage.

Sand bags are to be provided by the principle for use as anchor weights during construction. A nominal 30 bags are required at this stage. The liner supplier can supply these at a cost if required.

Safety stairs are to be provided in the locations as shown on drawings. The anchor trench detail is as per the drawings.

The anchor trench is to be excavated after the main pond earthworks are complete to ensure a stable batter slope.

An inlet pipe connection is to be installed through the liner using the proprietary compression connection details supplied by the liner installer.

Fill placement into the anchor trench is to be conducted by suitably sized plant so as to provide even placement of fill without damaging the liner. The fill in this trench is to be compacted to a minimum 93% MDD.

Gas Venting is required to be installed beneath the liner as per the Liner installer's recommendations.

The liner installer is to inspect and approve the final surface prior to installation of the liner, Liner installation results in the liner installer accepting the subgrade/shape and condition as suitable.

13 Health & Safety

All work must be in compliance with the Health and Safety in Employment Act. The following table from *IPENZ Practice Note 21: Farm Dairy Effluent Ponds* summarizes minimum hazard mitigation required around FDE ponds.

HAZARD MITIGATION AROUND FDE PONDS	
Fencing	Permanent and secure fencing to prevent stock and children from accessing FDE pond areas.
Gates	Lockable Access gates
Emergency Escape options	Permanent ladders and escape ropes.
Rescue buoy	A rescue buoy or similar on a rope that can be thrown to a person in the pond to help them keep afloat.
Anchor points	Anchor points to attach floating pontoons (if used) to improve stability.
Signage	Hazards on site clearly shown

The pond and any sumps that pose a health and safety hazard of falling, drowning and/or entrapment shall be fully fenced as deemed appropriate by the principles health and safety policy on farm. The fencing should be appropriate for the hazards, stock, personnel and accessibility by the type of individuals likely to enter the site. Guidance on fencing systems can be obtained on the Dairy NZ website.

Attachment F – Affected Party Approvals

environment SOUTHLAND

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Invercargill

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Fax No. (03) 211 5252
Southland Freephone No. 0800 76 88 45

File No: ______________
Officer in Charge: ______________

To: The General Manager
Environment Southland
Private Bag 90116
Invercargill 9840

WRITTEN APPROVAL OF A POTENTIALLY AFFECTED PARTY

Approval by Person(s) Potentially Affected by an Application for a Resource Consent

To be completed by the person requesting approval

Applicant: Schrader Mains Limited

pe of Resource Consent: Land Use Consent, Discharge Permit, Water Permit

Proposed Activity: Convert land to dairying. Discharge dairy effluent to land from 300 cows. Extract groundwater for the purpose of shed and stock water. Construct an inground effluent storage pond.

Location: 514 Rimu Seaward Downs Road, Waituna

To be completed by the person giving his or her approval:

Name: REX + HEATHER BOTTING

and/or Organisation: ______________

eet/Road Address: 677 WAITUNA ROAD WAITUNA.

I/we have sighted all the attached plans and supporting information for the above activity.

I/we hereby give approval for the proposal to be considered by Environment Southland without public notification.

I/we understand that, if I give my approval, Environment Southland shall not take into account any effects that the proposed activity may have on me, when considering the application (Section 104(3)(b) of the Resource Management Act 1991).

(Signature)

21 / 2 / 15
(Date)

NOTE: IF YOU DO NOT UNDERSTAND WHAT THIS FORM IS, OR DETAILS ABOUT THE APPLICATION ASSOCIATED WITH THIS FORM, DO NOT SIGN IT.

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Officer in Charge: ______________

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Environment Southland
Private Bag 90116
Invercargill 9840

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Applicant: Schrader Mains Limited

Type of Resource Consent: Land Use Consent, Discharge Permit, Water Permit

Proposed Activity: Convert land to dairying. Discharge dairy effluent to land from 300 cows. Extract groundwater for the purpose of shed and stock water. Construct an inground effluent storage pond.

Location: 514 Rimu Seaward Downs Road, Waituna

To be completed by the person giving his or her approval:

Name: Peter Henry Phiskie

and/or Organisation: HillBrea Trust

Street/Road Address: 160 Hills Road. Waituna RDI Invgill

I/we have sighted all the attached plans and supporting information for the above activity.

I/we hereby give approval for the proposal to be considered by Environment Southland without public notification.

I/we understand that, if I give my approval, Environment Southland shall not take into account any effects that the proposed activity may have on me, when considering the application (Section 104(3)(b) of the Resource Management Act 1991).

(Signature)

21/ 2 / 2015.
(Date)

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Location: 514 Rimu Seaward Downs Road, Waituna

To be completed by the person giving his or her approval:

Name: H + S Antiuk

and/or Organisation: AHOL Trust

Street/Road Address: 717 Rimu Road RD1 Ivgill 9871

I/we have sighted all the attached plans and supporting information for the above activity.

I/we hereby give approval for the proposal to be considered by Environment Southland without public notification.

I/we understand that, if I give my approval, Environment Southland shall not take into account any effects that the proposed activity may have on me, when considering the application (Section 104(3)(b) of the Resource Management Act 1991).

(Signature)

20/02/15
(Date)

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Officer in Charge: ______________

To: The General Manager
Environment Southland
Private Bag 90116
Invercargill 9840

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Type of Resource Consent: Land Use Consent, Discharge Permit, Water Permit

Proposed Activity: Convert land to dairying. Discharge dairy effluent to land from 300 cows. Extract groundwater for the purpose of shed and stock water. Construct an inground effluent storage pond.

Location: 514 Rimu Seaward Downs Road, Waituna

To be completed by the person giving his or her approval:

Name: Joan Walker

and/or Organisation: Farm Labourer

Street/Road Address: 5 Waituna morton mains Rd RD1 Ingl

I/we have sighted all the attached plans and supporting information for the above activity.

I/we hereby give approval for the proposal to be considered by Environment Southland without public notification.

I/we understand that, if I give my approval, Environment Southland shall not take into account any effects that the proposed activity may have on me, when considering the application (Section 104(3)(b) of the Resource Management Act 1991).

Walker
(Signature)

20/2/15.
(Date)

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Officer in Charge: ____________

To: The General Manager
Environment Southland
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Invercargill 9840
[redacted]

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Approval by Person(s) Potentially Affected by an Application for a Resource Consent

To be completed by the person requesting approval

Applicant: Schrader Mains Limited

'pe of Resource Consent: Land Use Consent, Discharge Permit, Water Permit

Proposed Activity: Convert land to dairying. Discharge dairy effluent to land from 300 cows. Extract groundwater for the purpose of shed and stock water. Construct an inground effluent storage pond.

Location: 514 Rimu Seaward Downs Road, Waituna

To be completed by the person giving his or her approval:

Name: Adrian Lawson

and/or Organisation: Glendoroch Farms Ltd

eet/Road Address: 24 Hills Road

I/we have sighted all the attached plans and supporting information for the above activity.

I/we hereby give approval for the proposal to be considered by Environment Southland without public notification.

I/we understand that, if I give my approval, Environment Southland shall not take into account any effects that the proposed activity may have on me, when considering the application (Section 104(3)(b) of the Resource Management Act 1991).

A.W. Lawson
(Signature)

19/2/2015
(Date)

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Officer in Charge: ______________

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Proposed Activity: Convert land to dairying. Discharge dairy effluent to land from 300 cows. Extract groundwater for the purpose of shed and stock water. Construct an inground effluent storage pond.

Location: 514 Rimu Seaward Downs Road, Waituna

To be completed by the person giving his or her approval:

Name: Winy van Rossum

and/or Organisation: Van Rossum Ltd

eet/Road Address: 346 Waituna Morton Mains Road
Rd1 Invercargill 9871

I/we have sighted all the attached plans and supporting information for the above activity.

I/we hereby give approval for the proposal to be considered by Environment Southland without public notification.

I/we understand that, if I give my approval, Environment Southland shall not take into account any effects that the proposed activity may have on me, when considering the application (Section 104(3)(b) of the Resource Management Act 1991).

(Signature)

18/ 2/ 2015
(Date)

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Invercargill 9840

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Approval by Person(s) Potentially Affected by an Application for a Resource Consent

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To be completed by the person requesting approval

Applicant: Schrader Mains Limited

Type of Resource Consent: Land Use Consent, Discharge Permit, Water Permit

Proposed Activity: Convert land to dairying. Discharge dairy effluent to land from 300 cows. Extract groundwater for the purpose of shed and stock water. Construct an inground effluent storage pond.

Location: 514 Rimu Seaward Downs Road, Waituna

To be completed by the person giving his or her approval:

Name: DAVID KEITH MORTON

and/or Organisation: ______________

Street/Road Address: 514 Rimu Seaward Downs Road Waituna

I/we have sighted all the attached plans and supporting information for the above activity.

I/we hereby give approval for the proposal to be considered by Environment Southland without public notification.

I/we understand that, if I give my approval, Environment Southland shall not take into account any effects that the proposed activity may have on me, when considering the application (Section 104(3)(b) of the Resource Management Act 1991).

DK Morton
(Signature)

18 / 2 / 15
(Date)

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Attachment G – Proposed Conditions of Consent

NOTE: It is noted that the following proposed conditions may be exercised together and linked as council see fit. The proposed conditions have been suggested with the most relevant controls for each consentable activity so that the effects of the activities are no more than minor.

Land Use Consent – To Establish a Dairy Farm

1. The term of this consent is unlimited.

2. This consent authorises the conversion and establishment of the subject land for use as a dairy farm as described in the application for resource consent dated 11 January 2017. The scope of the dairy farm activity to be established is described in the application as being:
    - ➢ The milking of up to 306 cows up to twice per day;
    - ➢ The use of land as a dairy farm on which winter grazing (between 1 June – 31 July) is not undertaken;
    - ➢ The construction, maintenance and operation of:
        - ◆ A dairy milking shed; and
        - ◆ Feed pad/standoff pad;
    - ➢ The discharge of dairy shed effluent and feed pad/stand-off pad effluent to a discharge area of no more than 96 hectares as per the plan attached as Appendix 1;
    - ➢ The establishment of environmental management practices as detailed in the Conversion Environmental Plan date 11 January 2017.

3. Prior to the exercise of this consent, all permanent waterways shall be fenced in such a way to exclude stock access at all times. Fences shall be set back from the waterways to create a minimum buffer zone of 3 metres between waterways and grazed pasture. 3 metres shall be measured horizontally from the outside edge of the wet bed of the waterway. For clarity, this shall apply to both sides of a waterway.

4.
    (a) Within 12 months of the first exercise of this consent, a riparian planting programme for the property shall be developed.
    (b) The riparian planting programme shall be designed by a suitable qualified person, and be designed to limit the degradation of riparian margins and surface water quality.

5. The consent holder shall notify the Consent Authority in writing within two months of the completion of the conversion authorised by this consent. The conversion is deemed to be complete when all infrastructure, including riparian fencing, is in place and the riparian planting programme is complete.

6. In accordance with Section 125(1) of the Resource Management Act, this consent shall lapse after a period of seven years after the date of commencement unless it is given effect to or an application is made to extend the lapse period before the consent lapses.

7. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent during the period 1 February to 30 September each year, or within two months of any enforcement action being taken by the Consent Authority in relation to the exercise of this consent, or on receiving monitoring results, for the purposes of:

(a) Determining whether the conditions of this permit are adequate to deal with any adverse effect on the environment, including cumulative effects, which may arise from the exercise of the permit, and which it is appropriate to deal with at a later stage, or which become evident after the date of commencement of the permit; or

(b) Ensuring the conditions of this consent are consistent with any National Environmental Standards Regulations, relevant plans and/or the Environment Southland Regional Policy Statement.

(c) Providing for review in the event that nutrient limits are determined for the Waituna Catchment.

Land Use Consent – To use land for dairy farming

1. This consent is granted for a period of 15 years

2. This consent authorises the use of the subject land for dairy farming as described in the application for resource consent dated 11 January 2017. The scope of the dairy farm activity is described in the application and Farm Management Plan as being:
    - the use of 109.52 hectares of land as a dairy farm;
    - the use of land as a dairy farm on which the grazing of dairy cows between 1 June – 31 July is not undertaken;
    - milking of up to 306 cows up to twice per day;
    - the construction and maintenance of:
        - a dairy milking shed;
        - Feed pad/standoff pad;
    - the establishment of environmental management practices as detailed in the Management Plan dated 11 January 2017.

3. The consent holder shall maintain a 3 metre riparian buffer from any waterway on the property of any cultivation and planting of fodder crop.

4. (a) The consent holder shall have and maintain a Management Plan for the subject site. This management plan shall be prepared in accordance with Appendix N of the proposed Southland Water and Land Plan and shall be a concise document which shall include, but not be limited to:

    (i) A site map showing the location of critical source areas; physiographic zones; permanent or intermittent rivers, streams, lake, drains, ponds or wetlands; where known the location and depth of any subsurface drainage systems including outlets, riparian vegetation and fences adjacent to waterways and stock access points across waterways.

    (ii) A nutrient budget based on soil nutrient tests prepared using OVERSEER in accordance with OVERSEER Best Practice Data Input Standards, or an equivalent model approved by the Chief Executive of Southland Regional Council.

    (iii) Good management practices for the site.

    (iv) A riparian management plan.

    (v) A cultivation map showing waterbodies, where cultivation is planned for the proceeding 1 June to 30 May and any proposed good management practices.

    (vi) If winter grazing is to be undertaken, a winter grazing management section.

    (vii) A Collected Agricultural Effluent Plan.

    (viii) If water irrigation is to be undertaken, an irrigation management section.

    (b) The Management Plan required by Condition 3 shall be reviewed once every twelve months. The results of the review shall be reported to the Consent Authority within one month of the review being undertaken. The review shall include but not be limited to:

    (i) A site map showing the location of critical source areas; physiographic zones; permanent or intermittent rivers, streams, lake, drains, ponds or wetlands; where known the location and depth of any subsurface drainage systems including outlets, riparian vegetation and fences adjacent to waterways and stock access points across waterways.

(ii) Details of the implementation of Good Management Practices

(iii) OVERSEER® parameter inputs report to confirm that the activity being carried out is in accordance with Condition 1 and nutrient losses remain consistent with those proposed at the time consent was sought.

(iv) A property specific environmental risk assessment, including a description of the risks to water quality, which shall be prepared by a suitably qualified person and which identified any farm specified environmental risks along with measures to mitigate the identified risks.

(v) Review of the data obtained from the monitoring undertake in accordance with the FEMP and any changes made or to be made as a consequence of that monitoring.

(vi) A report detailing items (i) – (iv) above shall be submitted to the consent authority no later than 31 July each year and shall include an updated version of the FEMP if any amendments have been made.

(vii) A report shall be prepared every three years by a suitable qualified independent person, i.e. a person who is a Certified Nutrient Management Advisor (or equivalent qualification and accreditation), and provided to the Southland Regional Council, Te Ao Marama and Southland Fish & Game by 31 July (2020, 2023, 2026, 2029, 2032) to demonstrate, using OVERSEER® modelling, that nutrient losses remain consistent with those proposed at the time the consent was sought.

Advice note: It is recognised that changes to the OVERSEER® model may give rise to changes in the modelled losses for the application site. Therefore, this condition does not require modelled nutrient losses to remain exactly the same as those modelled at the time consent was sought. Reviews of the Overseer Parameter Reports will enquire into and confirm that the farm system being applied by the consent holder is consistent with that promoted at the time the application for consent was sought whilst allowing for minor adjustments to be made to take account of varying climatic, soil conditions etc. that arise during the usual course of operating a dairy farm but that do not fundamentally alter the nature of the operation.

(c) Where there is a material change[28] in the land use associated with the farming activity, the nutrient budget as required under Condition 4(a)(ii) shall be reviewed and a new one shall be prepared at the end of the year the change occurs.

(d) If/when the plan is amended, a copy of the amended version, (or amended sections) shall be sent to the Consent Authority as soon as practicable following amendment.

(e) This permit shall be exercised in accordance with the Collected Agricultural Effluent Management Plan at all times. Where there is inconsistency between the Effluent Management Plan and the conditions of this consent, the conditions of this consent shall prevail.

5. If changes are made to the Management Plan, as part of the review required by Condition 4, the consent holder shall explain why the changes are required and how they ensure the continued use of land for dairy farming in accordance with good management practices.

6.

(a) Annual monitoring to be undertaken to assess effects on water quality. Details of the farm monitoring program are to be developed by a suitably qualified person and carried out by the

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[28] A material change is defined as that being a change exceeding that resulting from normal crop rotations or variations in climatic or market conditions

consent holder for the purpose of improving understanding of the effects of land use, and the discharge of effluent on water quality and to identify areas for improvement in management practices and further development of the FEMP. The monitoring program will include but not be limited to;

(i) Baseline sampling (i.e. prior to the dairy conversion);
(ii) Instream monitoring including in high flow events;
(iii) Monitoring of discharges from tile drains;
(iv) Soil sampling;
(v) Details regarding sampling methods and recording requirements for the information above;
(vi) The steps to be taken if monitoring identifies an increase in contaminants, particularly dissolved forms of nitrogen and phosphorous in water exiting the farm as compared to the quality of the water entering the farm;
(vii) The frequency of monitoring;
(viii) The parameters of monitoring including but not limited to;
  - (Nitrate +Nitrite) – Nitrogen
  - Total Ammonimical Nitrogen
  - Dissolved Reactive Phosphorous
  - *E.coli*

(ix) The frequency of reporting.

(b) Agricultural Good Practices to be employed on farm to minimise nutrient losses and mitigate effects on water quality. Implementation of industry agreed good management responses to avoid, remedy or mitigate any farm specific environmental risks to water quality and progress toward implementation of those management responses.

(c) Nutrient Management including;

(i) preparation and review of Overseer Budgets by a suitably qualified person to ensure that nutrient losses remain consistent with those proposed;'
(ii) Process for preparation and review of Overseer Budgets to account for changing versions of Overseer.
(iii) Application rates, locations and timing of fertiliser application;
(iv) Application rates and locations of dairy effluent application; Specify and implement a nutrient management system for the property, which is consistent with on farm management proposed in Overseer modelling submitted with the consent application;
(v) Maintenance of the following records for each year between 1 July and 30 June:
  - Fertiliser application, including rates;
  - Types of crops, including winter feed / forage crops;
  - Cultivation methods;
  - Stock units by reference to type, age and breed;
  - Prediction of realistic crops yields that are used to determine crop requirements and all other inputs to the Overseer nutrient budgeting model.

(vi) Fertiliser and soil management, including management and application of fertiliser in accordance with 'The Code of Practice for Nutrient Management (With Emphasis of Fertiliser Use)' Fertiliser Association, 2013, ISBN 978-0-473-28345-2' or any subsequent updates;

(d) Effluent Management Plan.
(e) Water Quality Management techniques.
(f) Methods for Achieving Consent Compliance.

7. Results obtained from the monitoring undertaken in accordance with the FEMP shall be provided to the Consent Authority by 31 July each year or no later than 2 weeks following a written request by the Southland Regional Council.

8. Subject to Condition 4 and 5, the Consent Holder shall at all times comply with the FEMP and any subsequent amendments or updates to the mitigation measures as required by conditions of consent or as a result of the annual review of the FEMP.

9. The consent holder shall pay an annual administration and monitoring charge to the Consent Authority, collected in accordance with Section 36 of the Resource Management Act, 1991. This charge may include the costs of inspecting the site up to three times each year (or otherwise as set by the Consent Authority's Annual Plan)

10. All cows must be transported out of the Waituna Catchment for grazing during 1 June and 31 July each year.

11. In accordance with Section 125(1) of the Resource Management Act, this consent shall lapse after a period of seven years after the date of commencement unless it is given effect to or an application is made to extend the lapse period before the consent lapses.

12. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent during the period 1 February to 30 September each year, or within two months of any enforcement action being taken by the Consent Authority in relation to the exercise of this consent, or on receiving monitoring results, for the purposes of:

    (a) Determining whether the conditions of this permit are adequate to deal with any adverse effect on the environment, including cumulative effects, which may arise from the exercise of the permit, and which it is appropriate to deal with at a later stage, or which become evident after the date of commencement of the permit; or
    (b) Ensuring the conditions of this consent are consistent with any National Environmental Standards Regulations, relevant plans and/or the Environment Southland Regional Policy Statement.
    (c) Ensuring the Mataura Freshwater Management Unit and Waituna Freshwater Sub Unit meets the freshwater objectives and freshwater quality limits set in an operative regional plan pursuant to Policy A1 of the National Policy Statement for Freshwater Management.

Discharge Permit – To Discharge Agricultural Effluent to Land from a Dairy Shed and Feed Pad/Standoff Pad

1. This consent is granted for a period of 15 years.

2.
   (a) This consent authorises the discharge of dairy shed effluent and feed pad/stand-off pad effluent onto land, via a land disposal system, as described in the application for resource consent dated 11 January 2017, and as amended by these conditions. The scope of the activity is described as being:
      - The discharge to land of dairy shed effluent generated from milking of up to 306 cows up to twice per day;
      - The discharge of feed pad/stand-off pad effluent generated from the use of the pad to land;
      - The discharge of effluent to land via a Larral Smart Hydrant system or equivalent low rate system and slurry tanker;
      - The discharge of effluent to 93 hectares of land as per the plan attached as Appendix 1; and
      - The discharge of effluent from a dairy farm on which winter grazing (1 June – 31 July) is not undertaken.

   (b) The consent excludes the discharge of dairy shed effluent from winter milking (defined as milking undertaken from 1 June to 31 July)

3. The discharge authorised by this consent shall not exceed the following rates at any time:
   (a) For the low rate system, a maximum depth of application of 20 millimetres for each individual application, at an instantaneous rate not exceeding 10 millimetres per hour;
   (b) For the slurry tanker, a maximum depth of application of 5 millimetres for each individual application;
   (c) The maximum loading rate of nitrogen onto any land area shall not exceed 150 kilograms of nitrogen per hectare per year; and
   (d) The minimum return period for the discharge of effluent to land shall be no less than 28 days.

4. There shall be no discharge when the soil moisture content of the soils is at or above field capacity. The consent holder shall measure soil moisture levels on farm prior to each effluent application to assess the suitability of the soils for receiving effluent. The consent holder shall keep a record of each measurement and the volume of effluent applied to the paddock, which shall be provided to Council by 31 July each year for the preceding 12-month period.

5. Effluent shall not be discharged within:
   (a) 20 metres of any surface watercourse;
   (b) 100 metres of any potable water abstraction point;
   (c) 200 metres of any residential dwelling not located on the subject property; and
   (d) 20 metres from any property boundaries;

   Where there is inconsistency between the plan shown in Appendix 1 and the conditions of this consent, the conditions of this consent shall prevail.

6. Prior to exercising this consent the consent holder shall provide at least 834 m^3 of effluent storage capacity for the purpose of avoiding irrigation of effluent when soils are at or above field capacity.

7. No effluent shall be discharged to any surface watercourse by overland flow, run-off, or via a pipe, nor shall there be any surface run-off/overland flow, ponding or contamination of water resulting from the exercise of this consent.

8. There shall be no odour beyond the boundary of the site as a result of the exercise of this consent that is offensive or objectionable

9.
   (a) Prior to the first exercise of this consent, the consent holder shall install and maintain an alarm and automatic switch off system as a contingency measure in the event of an effluent system failure, such as a sudden pressure drop, irrigator stoppage or break down.
   (b) Where the effluent reticulation system is installed in such a way that effluent can be siphoned when pumping ceases, the consent holder shall install and maintain an anti-siphon device in the effluent pipeline.

10.
   (a) Prior to the first exercise of this consent, the consent holder shall prepare, and submit to the Consent Authority, a Collected Agricultural Effluent Management Plan. The purpose of the plan is to provide direction to the consent holder's staff about the operation of the effluent system, including identification of environmental risks, to ensure compliance with the conditions of this consent. The plan shall be a concise document that is easy to use by all farm staff and shall include (but not limited):
      - a plan of how effluent will be managed when soils are at or above field capacity and/or during adverse weather conditions;
      - a maintenance schedule for effluent disposal infrastructure (maintenance of irrigators, checking anti-siphon/switch-off systems, desludging the storage system etc);
      - identification of drains, surface waterways, sub-surface drainage and critical source areas in the effluent disposal area so that appropriate management procedures can be implemented to avoid the risk of effluent entering water;
      - a plan of how effluent application rates and soil temperature will be monitored to ensure the consent requirements are being met;
      - Methodology for monitoring and completing calibration tests of the effluent system to ensure the system is operating in accordance with the conditions of this consent.
      - Details regarding the management of effluent generated from the operation of the feed pad/stand-off pad or any other associated infrastructure;
      - Details of the methodology for undertaking soil moisture monitoring prior to the application of Effluent; and
      - Details of records to be kept to demonstrate compliance with the conditions of this consent.

   (b) The Collected Agricultural Effluent Management shall be reviewed at least on an annual basis to check that it still accurately reflects on-site activities and whether any improvements to management procedures need to be made. The results of the review shall be reported to the Consent Authority within one month of the review being undertaken.

   (c) If/when the plan is amended, a copy of the amended version, (or amended sections) shall be sent to the Consent Authority as soon as practicable following amendment.

   (d) This permit shall be exercised in accordance with the Collected Agricultural Effluent Management at all times. Where there is inconsistency between the Collected Agricultural Effluent Management Plan and the conditions of this consent, the conditions of this consent shall prevail.

(e) The Collected Agricultural Effluent Management Plan required by Condition 12(a) can also be part of the Management Plan required under Land Use Consent [CONSENT NUMBER].

11.

(a) Annual Monitoring to be undertaken by the consent holder to assess effects on Water Quality. The FEMP shall provide details of the farm monitoring program to be carried out by the Consent Holder for the purpose of assessing the effectiveness of, and demonstrating compliance with good management practices and to identify areas for improvement in management practices which may reduce the effects of the discharge of effluent on water quality as on-going development of the FEMP. The monitoring program will include but not be limited to;

(a) Monitoring of Critical Source Areas and tile drain discharge from the property; Bi-annual (i.e. at least twice per year) sampling of discharge from a minimum of 3 tile-drain outlets per sampling occasion is to occur when soil moisture is at or above 75% of field capacity and there is (or predicted) more than 10 mm of rainfall over a 24-hour period or when flow in Environment Southland's Waituna Creek at Marshall Road monitoring site is above 5,000 litres per second. The tile-drain sampling sites shall be measured for:

- Flow
- Total suspended solids
- Nitrate + Nitrite – Nitrogen
- Total ammoniacal nitrogen
- Dissolved organic nitrogen
- Total nitrogen
- Dissolved reactive phosphorous
- Total dissolved phosphorus
- Total phosphorus
- *E. coli*
- Electrical conductivity

Water quality samples are to be analysed by an ISO accredited laboratory and samples taken in accordance with the United States Geological Survey (USGS) National Field Manual for the Collection of Water-Quality Data (October 2015)

(ii) Monitoring of Groundwater Quality; A groundwater sample is to be taken between 1st September and 31st October and between 1st March and 30th April each year. All samples shall be tested for:

- Nitrate + Nitrite – Nitrogen
- Dissolved reactive phosphorous
- *E. coli*
- Electrical conductivity
- Total chloride

The first year of sampling shall also include:

- Total iron
- Total manganese
- Total ammoniacal nitrogen

Water quality samples to be analysed by an ISO accredited laboratory and samples taken in accordance with the United States Geological Survey (USGS) National Field Manual for the Collection of Water-Quality Data (October 2015).

(iii) The consent holder shall ensure that a bore or well is available onsite for the purpose of monitoring groundwater quality as set out in (ii) above. The b ore or well shall;

- Be located downstream of the discharge area, as shown on the plan attached as Appendix 1 to this consent, or at an alternative location agreed in writing with the Consent Authority;
- Be 4-5 metres below the static groundwater level, and screened on the bottom 2 metres;
- Have an internal diameter of between 50 and 100 millimetres;
- Be used solely for monitoring purposes, or otherwise as agreed upon in writing with the Consent Authority.

(iv) If groundwater sampling results indicate that nitrate concentrations exceed 8.5 mg/L (i.e. 75% of the maximum acceptable level for the New Zealand Drinking Water Standards) and/or if the averaged tile drain load exceeds 29 kg N/ha/year or 0.7 kg P/ha/year (or equivalent if the Overseer version changes), then an investigation into the cause of nutrient loss must be undertaken by a suitably qualified person(s) within 2 weeks of receiving the lab results. The investigation may consist of, but not be limited to:

- a farm inspection to identify likely contaminant sources, including and elevation of Critical Source Areas
- Additional water quality monitoring (e.g. upstream and downstream of the property) to determine whether the issue is occurring on the property, and/or sampling of additional water quality parameters to help identify the contaminant source(s)
- The result of the investigation including any changes in farm management practices, must be reported to Environment Southland within 2 weeks of the completion of the investigation and must be incorporated within the annual review of the FEMP.

(v) Annual soil sampling; A representative soil sample at a block level will be undertaken at least once during any 12-month period for the duration of the consent to establish the nutrient status of the soils. All samples are to be analysed by an ISO accredited laboratory.

(vi) A monitoring report shall be provided to Environment Southland by the 31st July each year and shall consist of, but not be limited to:

- field sampling notes
- lab results

12. Prior to the exercise of this consent, the consent holder shall notify the Consent Authority of who is the assigned operator of the effluent disposal system. If a new operator is appointed, the consent holder shall notify the Consent Authority within five working days.

13. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent during the period 1 February to 30 September each year, or within two months of any enforcement action being taken by the Consent Authority in relation to the exercise of this consent, or on receiving monitoring results, for the purposes of:
    (a) Determining whether the conditions of this permit are adequate to deal with any adverse effect on the environment, including cumulative effects, which may arise from the exercise of the permit, and which it is appropriate to deal with at a later stage, or which become evident after the date of commencement of the permit; or
    (b) Ensuring the conditions of this consent are consistent with any National Environment Standards Regulations, relevant plans and/or the Environment Southland Regional Policy Statement; or
    (c) Amending the monitoring programme to be undertaken; or
    (d) Adding or adjusting compliance limits; or
    (e) Requiring the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment arising as a result of the exercise of this permit.
    (f) Ensuring the Mataura Freshwater Management Unit and Waituna Freshwater Sub Unit meets the freshwater objectives and freshwater quality limits set in an operative regional plan pursuant to Policy A1 of the National Policy Statement for Freshwater Management.

Water Permit – To Abstract Groundwater for Stock and Shed Water Purposes

2. This consent is granted for a period of 15 years.

3. The permit authorises the taking of groundwater from up to two bores located at;
   NZTM 2000: 1264502E 4851627N
   NZTM 2000: 1264616E 4851107N

4. The rate of abstraction shall not exceed:
   - 2 litres per second;
   - 36,720 litres per day; and
   - 11,120 cubic metres per year.

   For the purpose of this consent a 'year' shall be 1 July to 30 June in the following calendar year.

5. Prior to the first exercise of this consent, the consent holder shall install a backflow prevention device or take other appropriate measures to ensure water and/or contaminants cannot return to the water source.

   (a) Prior to the first exercise of this consent, the consent holder shall install a water meter to record the water take, within an error accuracy range of +/- 5% over the meter's nominal flow range, and datalogger with at least 24 months data storage to record the rate and volume of take, and the date and time this water was taken. The consent holder shall forward a copy of the installation certificate to the Consent Authority within one month of installing the water meter and datalogger.

   (b) The water meter shall be installed in a straight length of pipe, before any diversion of water occurs. The straight length of pipe shall be part of the pump outlet plumbing, easily accessible, have no fittings and obstructions in it. There shall be a straight length of pipe on either side of the water meter: on the upstream side there shall be a distance that is 10 times the diameter of the pipe and on the downstream side there shall be a distance of 5 times the diameter of the pipe.

   (c) The consent holder shall ensure the full operation of the water meter and datalogger at all times during the exercise of this consent. All malfunctions of the water meter and/or datalogger during the exercise of this consent shall be reported to the Consent Authority within 5 working days of observation and appropriate repairs shall be performed within 5 working days. Once the malfunction has been remedied, a Water Measuring Device Verification Form completed with photographic evidence must be submitted to the Consent Authority within 5 working days of the completed of repairs.

   (d) If a mechanical insert water meter is installed it shall be verified for accuracy each and every year from the first exercise of this consent;

      1. Any electromagnetic or ultrasonic flow meter shall be verified for accuracy every five years from the first exercise of this consent;
      2. Each verification shall be undertaken by a Consent Authority approved operator and a Water Measuring Device Verification Form shall be completed and supplied to the Consent Authority with receipts of service. These shall be supplied within 5 working days of the verification, and at any time upon request.

(e) The consent holder shall provide records from the datalogger to the Consent Authority via a system that can automatically send the data into the Consent Authority's computer database in CSV format, Hilltop or Tideda format, or XML formatted as required by Hilltop software. The consent holder shall provide records from the datalogger to the Consent Authority by 31 July each year and at any other time on request.

5. The consent holder shall pay an administration and monitoring charge to the Consent Authority collected in accordance with Section 36 of the Resource Management Act, payable in advance on 1 July each year.

6. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent during the period 1 February to 30 September each year, or within two months of any enforcement action being taken by the Consent Authority in relation to the exercise of this consent, or on receiving monitoring results, for the purpose of:

   (a) Adjusting the consented rate or volume of water under Condition 3, should monitoring under Condition 4(a) or future changes in water use indicate that the consented rate or volume is not able to be fully utilised; or
   (b) Determining whether the conditions of this consent are adequate to deal with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage; or
   (c) Ensuring the conditions of this consent are consistent with any National Environmental Standards Regulations, relevant plans and/or the Environment Southland Regional Policy Statement; or
   (d) Adjusting or altering the method of water take data recording and transmission.

Land Use Consent – Bore Consent

14. This consent is granted for a period of 5 years.

15. This resource consent authorises the construction of a bore at or about N: 4851107 E: 1264616 (NZTM), within the area shown on the map attached as Appendix A.

16. Where the bore/well is to be maintained as a permanent installation, construction shall comply with NZS4411:2001. In particular:
    a. The top of the bore/well casing shall extend at least 300 mm above ground level.
    b. A seal, made of concrete or similar material, is to be placed at ground level around the outside of the casing. The seal shall be sufficient to prevent foreign material, surface water, spillage or other leakage entering the space between the casing and the wall of the borehole.
    c. The top of the casing shall be sealed to prevent the entry of contaminants.
    d. Flowing artesian bores/wells shall be fitted with headworks to control artesian pressures and avoid the uncontrolled discharge of water.
    e. The following shall be provided;
        (i) A filter pack comprising clean, washed sand (typically 2 to 4 mm) shall be placed around the screened interval. The filter pack shall extend at least 200 mm above the screened interval;
        (ii) A bentonite seal (typically bentonite pellets) shall be placed above the filter to prevent ingress of water via the bore annulus. The bentonite seal shall typically extend >2 m above the filter pack;
        (iii) The remainder of the bore annulus can be back-filled with clean material.
    f. Bores/wells intended for water abstraction or groundwater monitoring shall comply with the following:
        (i) The screened interval should be placed near the estimated lowest water table depth.
        (ii) A structure shall be placed around the bore/well to exclude stock from the immediate vicinity of the bore/well.

    In the event that the bore/well is not to be maintained as a permanent installation, decommissioning and filling shall also be in accordance with NZS4411:2001.

4. Prior to the expiry of this consent, the following information shall be provided to the Consent Authority:
    (a) Details of the bore/well location(s) (GPS reference or site plan)
    (b) Details of bore/well construction including:
        - Drilled depth
        - Casing depth
        - Screened intervals; and
        - Casing and screen materials

    (c) Geological logs, including water table depth
    (d) Details of pumping tests carried out.

5. Where more than one aquifer is encountered during drilling, the bore/well shall be constructed so that groundwater is drawn from one primary aquifer, and so that leakage between zones of differing pressure or water quality is prevented.

6. In the event of discovery, or suspected discovery, of a site of cultural importance (Waahi Taonga/Tapu), the consent holder shall immediately cease operations in that location and inform the local iwi authority (Te Ao Marama Inc., Phone: (03) 931 1242). Operations may recommence with the written permission of the Consent Authority. The discovery of Koiwi (human skeletal remains) or Taonga or artefact material (e.g. pounamu/greenstone) would indicate a site of cultural importance. *Note: A protocol outlining the process in the event of such a discovery can be obtained from Environment Southland.*

Land Use Consent – Pond Storage

1. This consent is granted for a period of 5 years.

2. This consent authorises the construction of an agricultural effluent pond, as described in the application for resource consent dated 11 January 2017 with capacity to store at least 834 cubic metres of effluent.

3. (a) The effluent storage pond must be designed, and the construction supervised, by a suitably qualified person. The pond shall be constructed of suitable materials, and shall be designed and constructed in such a manner that it is structurally sound and will not leak.

   (b) The supervising suitably qualified person shall, upon completion of the construction, confirm in writing to the Consent Authority that the pond has been designed and constructed in accordance with the conditions of this consent and the "Environment Southland Code of Practice for Design and Construction of Agricultural Effluent Ponds, March 2009" (escompliance@es.govt.nz).

   (c) No effluent may be stored in the pond until the confirmation required by Condition 3(b) is received by the Consent Authority.

4. The effluent pond shall not be constructed within:
   - 50 metres of any surface watercourse;
   - 100 metres of any water abstraction point;
   - 50 metres of any property boundary;
   - 200 metres of any residential dwelling, other than residential dwellings on the property.

5. All practicable measures are taken to prevent the discharge or leakage of contaminants to water, or onto or into land in circumstances where they may enter water, both during construction of the pond and once the pond is completed.

6. If an event (such as effluent overflow to water or pond collapse) occurs that may have significant adverse effect on water quality, particularly at the abstraction point of a registered drinking-water supply, the consent holder shall notify, as soon as reasonably practicable, the following:
   - The Consent Authority (Ph: 03 211 5115 or 03 211 5225 after hours);

7. The consent holder shall pay an annual administration and monitoring charge to the Consent Authority, payable on invoice. This charge may include the costs of inspecting the operation of this resource consent.

8. In the event of discovery, or suspected discovery, of a site of cultural importance (Waahi Taonga/Tapu) during the effluent pond construction, the consent holder shall immediately cease operations in that location and inform the local iwi authority (Te Ao Marama Inc., Phone: (03) 931 1242). Operations may recommence at a time as agreed upon in writing with the Consent Authority. The discovery of Koiwi (human skeletal remains) or Taonga or artefact material (e.g. pounamu/greenstone) would indicate a site of cultural importance. *Note: A protocol outlining the process in the event of such a discovery can be obtained from Environment Southland.*