Albert van Oostrom & Associates
21 Dawson St
Hamilton East
Hamilton 3216
New Zealand
Phone: +64 (7) 856 8367
Mobile: +64 (27) 485 9234
Email: avo@albert.co.nz

1 September 2016

Horizons Regional Council
Private Bag 11025
Manawatu Mail Centre
Palmerston North 4442

Attention: Luka de Jong

Dear Luka

FJ Ramsey (Trading) Limited - Application Number App- 1999007961.02 - Request for Further Information

Thank you for your letter of 8 March 2016 requesting further information in regard to the FJ Ramsey (Trading) Limited ("Crusader Meats") consent application for discharge of meat processing wastewater onto and into land. Below is the requested information in the order set out in your letter.

Management Plan

The application acknowledges that the current discharge has resulted in an increase in nutrient levels within the streams that run through the irrigation property. This suggests that the current management regime of the land treatment system is not being managed as effectively as it could be, and that the uptake of nutrients is not being achieved within the soil profile and, therefore, may need to be reviewed.

- *Please provide a copy of the current Management Plan I regime for the site. If there is no Management Plan available for the site, please provide the management practices and mitigation methods used to ensure optimal uptake of nutrients within the soil profile.*

- *Please identify any new best management practices that will be adopted to mitigate the potential effects of an increase in the maximum irrigation volume; the discharge of up 1,500m3/day of wastewater and slurry wastes from meat processing. This may be included in an updated management plan can be supplied in relation to this request.*

An updated irrigation management plan for the site is attached in Appendix 1.

Please note that the levels of soluble nutrients (especially DRP) in streams that run from and through the irrigation property, as measured on 2 November 2015, were often lower than in the Waimiha Stream.

Slightly elevated total phosphorus levels in some samples are at least partly attributable to a sampling artefact. Due to very low flows and water levels at some of the sampling sites, some samples unavoidably contained small amounts of sediment.

Small increases in nutrient levels can be expected in streams flowing through farmland, with or without wastewater irrigation. The nutrient levels observed in the streams flowing though the irrigation property are not an indication that the irrigation is poorly managed.

The applicant proposes to regularly monitor the water quality in the main stream that runs through the Tutaki block (refer Section 4.7 of the Irrigation Management Plan). Over time the monitoring results should help in assessing any effects of the irrigation activity, but the results currently available are insufficient to discern significant effects.

The monitoring of the stream running through the Tutaki Block is proposed to be undertaken instead of the additional Waimiha Stream "Downstream 2" sampling site proposed in the AEE. The "Downstream 2" sampling site is difficult to access and the monitoring results for this site would be of much less value for monitoring the effects of the irrigation than the monitoring of the stream that flows through the Tutaki Block.

Nutrient Budget

Please provide a nutrient budget that allows Horizons Regional Council to evaluate the current leaching levels as well as assess the possible effects of the proposed increased volume of wastewater and nutrient loads applied to land.

Overseer is a model that can be used to show the nutrient leaching levels under the current irrigation management system as well as where possible reductions can be made to ensure the proposed discharge will result in reductions in nutrient levels reaching the waterways.

We have used Overseer version 6.2.2 to estimate the leaching levels on the Tutaki Block for two scenarios:

- Scenario 1: "Current leaching levels" for effluent and slurry nitrogen loads applied during the period 1 July 2014 to 30 June 2015.
- Scenario 2: "Worst case leaching levels" for effluent and slurry nitrogen loads applied at the maximum permitted rate of 200 kg N/ha.year to all land application sites.

Model inputs are summarised below. Detailed input parameters are given in Appendices 2 and 3.

- Both scenarios were modelled using the stock number and types, silage production, and other farm management information for the period 1 July 2014 to 30 June 2015.
- The farm management blocks modelled are described in Table 1 and Table 2.
- The soil properties used for each block were those of the dominant soil S-map soil family/sibling within the block (Table 6).
- The Climate Station tool in Overseer was used to estimate the climate for the farm, with coordinates: 38.5158° S, 175.4463° E
- Most of the runoff and shallow groundwater from the land application sites flows through various types of natural wetland before entering streams on the property. We have not included the

wetlands in nutrient budget; therefore, estimates of nutrient losses to water are considered to be conservative in this respect.

- As Overseer options for modelling irrigation of industrial wastewaters are limited, the meat effluent was defined as "Fertiliser>Organic>Custom Dairy Factory Effluent" with the following nutrient concentrations (g/m³): N - 100; P - 20; K - 110, S - 30; Ca - 20; Mg - 10; Na - 100. These concentrations are averages for the Crusader Meats effluent from 1 July 2010 to 30 May 2015 rounded to the input requirements of the software.
- Manure slurry was defined as "Fertiliser>Organic>Other Organic Material" with the following parameters (% DM): N - 3.2; P - 0.8; K - 2.0, S - 0.5; Ca - 0.5; Mg - 0.1; Na - 0.2; Percentage of N in inorganic form – 15%. DM content 8%.
- Pond slurry was defined as "Fertiliser>Organic>Other Organic Material" with the following parameters (% DM): N - 2.4; P - 0.2; K - 0.4, S - 0.7; Ca - 0.7; Mg - 0.1; Na - 0.2; Percentage of N in inorganic form – 15%. DM content 3%.
- Average monthly nitrogen application rates modelled are given in Table 3.

Table 1
Tutaki Farm management blocks modelled in Overseer

Block Name	Area (ha)		Description
	Scenario 1	Scenario 2	
Pastoral irrigated	97.6	97.6	Sites irrigated with effluent.
Pastoral manure slurry application	13.8	6.6	Manure slurry spreading sites.
Pastoral pond slurry application	-	7.2	Pond slurry spreading sites (Pond slurry is applied every two years and modelled in Scenario 2 only as pond slurry was not irrigated in 2014/15).
Pastoral buffer zones	65	65	Pastoral areas between land treatment sites and streams etc. that receive no applications of effluent, slurry or fertiliser (other than lime).
Trees and scrub	14	14	Areas covered in trees and scrub inaccessible to stock. Includes streams running through these areas.
Non-productive areas	32.1	32.1	Includes streams, ponds, lanes, yards, and trees and scrub potentially accessible to stock.
Total	222.5	222.5	

Table 2 Selected details of farm management blocks defined in Overseer for the Tutaki property.					
Block Name	Pastoral irrigated	Pastoral manure slurry application	Pastoral pond slurry application	Pastoral buffer zones	Trees and scrub
Area (ha)	97.6	6.6	7.2	65	14
Topography	Rolling	Rolling	Rolling	Easy Hill	-
Distance from Coast (km)	71	71	71	71	71
Cultivated in last 5 years	Yes	No	No	No	-
Bush type	-	-	-	-	Native
Daily rainfall pattern setting	1450-2900 mm, Moderate				
Mean annual rainfall (mm)*	1646				
Mean annual temp. (°C)*	10.9				-
Annual PET (mm)*	676				-
PET seasonal variation	Moderate				-
Soil S-map name	Maro_11a.1	Ngong_10a.1		Maro_11a.1	-
Soil Olsen P**	18	11		7	-
Soil QT K**	6	4		4	-
Soil QT Ca**	5	5		3	-
Soil QT Mg**	10	8		7	-
Soil QT Na **	7	4		4	-
Soil Organic S (mg/kg)	7	7		7	-
Phosphate retention	42%	42%		42%	-
Profile drainage class	Well				-
Soil hydrophobic condition	Rain always soaks in				
Soil susceptibility to pugging or treading damage	Rare				-
Soil is compacted?	No				-
Artificial drainage	None				-
Run-off is intercepted by a fenced grass filter strip	No				-
Pasture type	Ryegrass/white clover				-
Supplements made***	800 silage bales	None	None	None	-
Supplements destination	300 silage bales fed evenly over pastoral land application block and 500 sent off-farm or stored.				-
Fertiliser/organic products applied	Refer Table 3			Lime only	-
Stock types and numbers	Sheep and beef as per 2014/15				-

* Determined using NIWA Climate Station tool within Overseer for coordinates: 38.5158° S, 175.4463° E

** Average results from annual soil monitoring.

*** Based on 2014/15 season silage production

Table 3 Average monthly nitrogen application rate (kg/ha)					
Month	Scenario 1		Scenario 2		
	Effluent 97.6 ha	Manure slurry 13.8 ha	Effluent 97.6 ha	Manure slurry 6.6 ha	Pond slurry 7.2 ha
Jul	15.6	1.7	16.7	3.9	0
Aug	13.6	1.7	12.9	3.9	0
Sep	13.6	1.7	14.5	3.9	0
Oct	19.5	1.7	21.6	3.9	0
Nov	7.2	3.5	9.8	8.1	200
Dec	16.7	13.9	16.2	32.1	0
Jan*	10.9	13.9	21.0	32.1	0
Feb*	0.0	13.9	20.5	32.1	0
Mar*	23.4	13.9	22.2	32.1	0
Apr	18.2	10.3	15.6	24.0	0
May	16.3	7.0	15.1	15.8	0
Jun	19.9	3.5	13.9	8.1	0
Total	175.1	86.5	200	200	200

* For Scenario 1, some or all effluent was irrigated on the Te Hape Block during Jan, Feb and Mar.

Nutrient budget reports for Scenarios 1 and 2 are attached in Appendices 2 and 3, respectively.

Whole farm nitrogen lost to water is 27 kg N/ha.year for Scenario 1 (Table 4) and 29 kg/ha.year for the "worst case" Scenario 2 (Table 5) in which all irrigable areas in the Tutaki Block receive the maximum proposed nitrogen loading.

For Scenario 2, nitrogen lost to water from the irrigation management block is estimated to be 49 kg N/ha.year with the removal of 52 kg N/ha.year in silage. Nitrogen lost to water for the manure slurry application block is higher, mainly because silage is not normally harvested from this block.

For both scenarios, whole farm phosphorus lost to water is estimated as 1.2 kg/ha.year (Appendices 2 and 3).

Almost all of the nitrogen lost to groundwater and ultimately to the Waimiha Stream occurs during winter (April to October) as shown in "Change in N Pools" graphs in Appendices 2 and 3. During winter, river flows tend to be high and the effects of nutrients in water are much lower than during summer.

Soil characteristics and farm management in the land application areas of the Te Hape B and Tiroa E blocks are similar to those for the Tutaki Block, and therefore nutrient losses are also expected to be similar for those blocks.

Crusader Meats proposes to prepare nutrient budgets annually for the land application sites to assist with improving land application and farming activities to reduce nutrient losses as far as practicable (refer Section 4.8 of the Irrigation Management Plan).

Table 4

Block nitrogen summary for Scenario 1

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 irrigated	4559	47	4.1	134	175
Pastoral manure slurry appln	492	36	3.6	112	87
Pastoral buffer zones	896	14	N/A	45	0
Trees and scrub	42	3	N/A		
Other farm sources	52				
Whole farm	6041	27			
Less N removed in wetlands	0				
Farm output	6041	27			

Table 5

Block nitrogen summary for Scenario 2

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 irrigated	4813	49	4.2	155	200
Pastoral manure slurry appln	404	61	6.3	211	200
Pastoral buffer zones	897	14	N/A	46	0
Trees and scrub	42	3	N/A		
Pastoral pond slurry appln	316	44	4.5	211	200
Other farm sources	52				
Whole farm	6524	29			
Less N removed in wetlands	0				
Farm output	6524	29			

Soil Map

Please provide a soil map showing the soil series classifications for the discharge land areas. This will enable Horizons Regional Council to evaluate the ability of the different soil types to handle various hydraulic and nutrient loadings.

A soil map for the land discharge sites is given in Figure 1 and approximate areas of each soil type are summarised in Table 6. An S-map Soil Report for each dominant soil family and sibling is attached in Appendix 4.

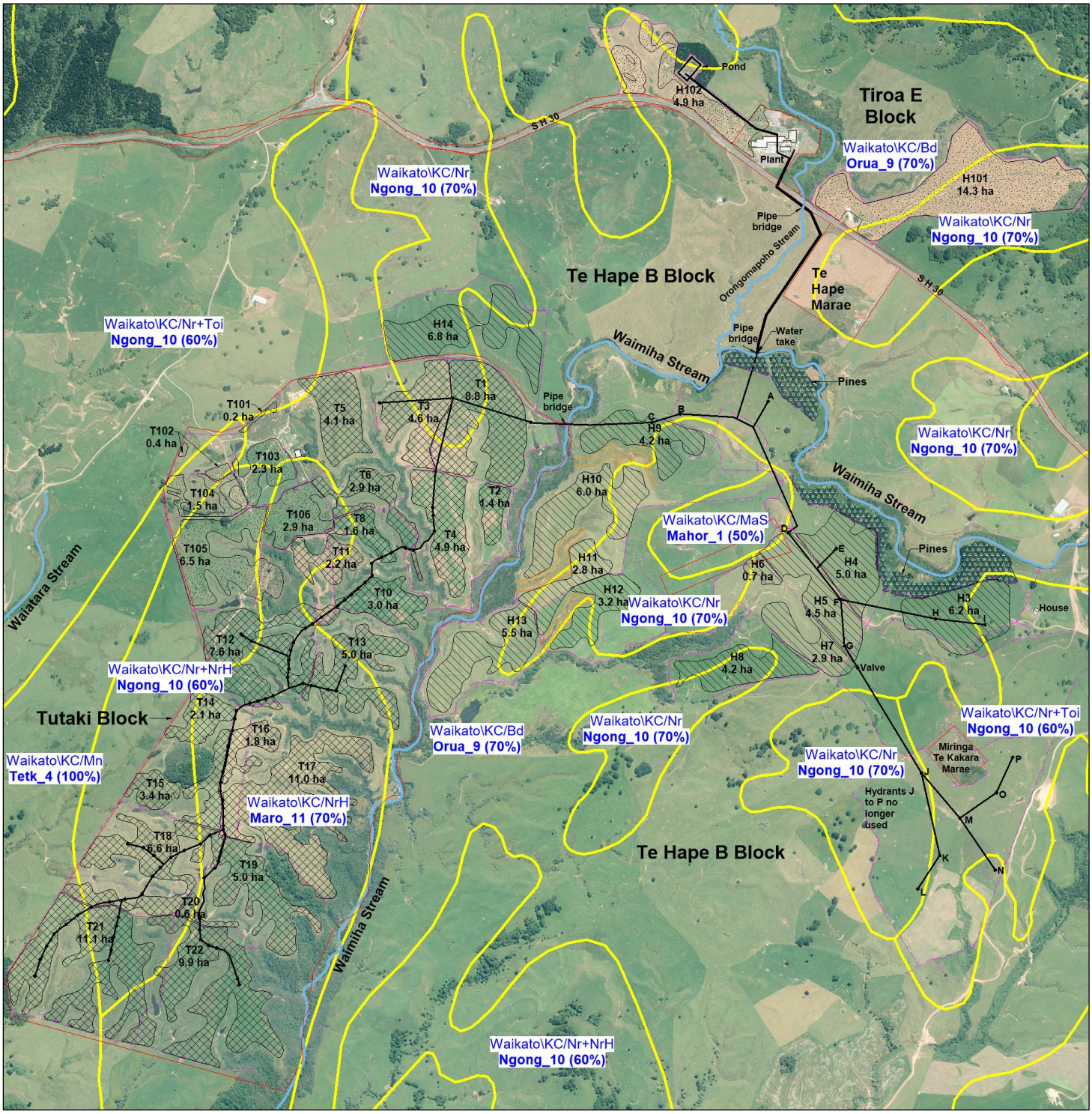


Figure 1

Soil map showing areas of similar soil information (yellow boundaries) and the dominant soil family and sibling in each area (proportion of area is shown in brackets). Source: Landcare Research S-map Online.

Table 6 Selected S-map soil properties and approximate area of each soil type in the land discharge sites.					
Soil type	Figure 1 label:	Orua_9	Maro_11	Ngong_10	Tetk_4
	Soil classification	Podzolic Orthic Pumice Soil	Humose Orthic Podzol	Humose Orthic Podzol	Typic Orthic Pumice Soil
	Family	Orua*f*	Maroa*f*	Ngongotaha*f*	Te Toka*f*
	Sibling number	9	11	10	4
	Soil profile material	Tephric soil	Tephric soil	Tephric soil	Tephric soil
Properties	Depth class	Deep (>1 m)	Deep (>1 m)	Deep (>1 m)	Deep (>1 m)
	Texture profile	Sandy loam	Loam over sandy loam	Loam	Loam over sandy loam
	Potential rooting depth	Unlimited	Unlimited	Unlimited	Unlimited
	Topsoil clay range	5-8%	10-15%	10-15%	10-20%
	Drainage class:	Well drained	Well drained	Well drained	Well drained
	Permeability	Rapid	Moderate	Rapid	Rapid
	Profile available water (0-60 cm)	Moderate (89 mm)	Very high (128 mm)	Very high (113 mm)	High (104 mm)
	Dry bulk density, topsoil	0.85 g/cm³	1.09 g/cm³	1.09 g/cm³	0.91 g/cm³
	Water logging vulnerability	Very low	Very low	Very low	Very low
	Drought vulnerability - if not irrigated	Low	Low	Low	Low
	Topsoil P retention	Medium (51%)	Medium (42%)	Medium (42%)	Medium (51%)
	N leaching vulnerability	Medium	Low	Low	Low
	Bypass flow	Medium	High	High	Medium
	Relative Runoff Potential	Very Low	Very Low	Very Low	Very Low
Areas	Te Hape B irrigation sites				
	Area (ha)	33.2	-	18.8	-
	Area (%)	64%	-	36%	-
	Tutaki irrigation sites				
	Area (ha)	28.1	41.0	22.6	5.9
	Area (%)	29%	42%	23%	6%
	Tiroa E slurry spreading sites				
	Area (ha)	10.1	-	9.1	-
	Area (%)	53%	-	47%	-
	Tutaki slurry spreading sites				
	Area (ha)	1.1	3.9	7.7	1.1
	Area (%)	8%	28%	56%	8%
	All land treatment sites				
	Area (ha)	72.6	44.9	58.1	6.9
	Area (%)	40%	25%	32%	4%

Additional Mitigation Measures

Please discuss any additional mitigation measures that could be carried out to reduce nutrient leaching, including but not limited to:

- *an increased in pond storage capacity to practice deficit irrigation;*
- *installation of soil moisture meters within irrigation areas; and*
- *an increase in land area used for irrigation.*

The applicant proposes to increase pond storage capacity to meet the 90% probability storage volume determined using the *Dairy Effluent Storage Calculator (DESC),* as discussed in the Pond Storage section below. This level of storage would significantly reduce nutrient losses to water but it would not provide for true "deficit irrigation" where the depth of water applied never exceeds the soil moisture deficit below field capacity. To achieve 100% deficit irrigation with no increase in soil drainage would require several months' effluent storage, which would not be practicable.

Soil moisture meters alone are one of several tools that can be used to estimate soil moisture conditions for managing the timing of irrigation. Crusader Meats is investigating the installation of an automated weather and soil monitoring station at a representative location on the Tutaki Block to estimate evapotranspiration and the soil moisture deficit. This would complement the current method of daily visual soil inspection.

An increase in the land area irrigated would reduce the nitrogen application rate and nutrient leaching. The currently available land is limited by agreements with the landowners and by the extent of the reticulation system, and is sufficient to irrigate up to around 150% of current wastewater production at a nitrogen application rate of 200 kg/ha.year.

Approximately 28.5 ha of the available land (sites H9-H13) has not been used to date. These sites are adjacent to wetlands that are required to be fenced and planted before irrigation on this land can commence. The applicant proposes to fence and plant the wetlands and make use of this land before any significant increase in production at the site, as discussed in the Wastewater Volume Increase section below.

Another mitigation measure proposed is the irrigation of supplementary water during dry periods as described in Section 3.2.8 of the Management Plan.

Wastewater Volume Increase

Please explain how the applicant proposes to mitigate effects of the increased volume of wastewater discharge to land to ensure the activity does not result in further increase in nutrient levels in surface waterbodies, and how improvements can be made to the quality of the wastewater that is discharged to land.

The proposed increase in the daily irrigation volume to 1500 m^3 provides for either of the following options:

1. An increase in effluent produced and irrigated.
2. No increase in plant or effluent production, but an increase in the maximum daily volume irrigated from the storage pond. This would involve a proportionate decrease in the number of irrigation events.

For both options, no increase in the irrigation *application rate* or *depth* is required or proposed. To increase the daily irrigation volume will require a proportionate increase in the number of irrigators. For example, to irrigate 1,500 m^3 of effluent per day would require the number of K-line irrigation sprinklers to be increased from 90 to 150.

The scale of potential environmental effects is different for the two options. Option 1, involves an increase in effluent production and associated nutrient loads, with the potential to increase nutrient leaching. Potential options to avoid or minimise adverse effects include increasing effluent storage capacity, pre-treating the wastewater to reduce nutrient concentrations, increasing the area of land to which the wastewater is applied, removing more nutrients from the soil through “cut-and-carry” practices, and other land management practices such as irrigating supplementary water during very dry periods.

Option 2 does not involve any increase in effluent production or potential adverse effects. On the contrary, an ability to irrigate more effluent when soil moisture conditions are most suitable to receive the effluent increases capacity to defer irrigation when soil conditions are less suitable. The proposed increase in daily irrigation volume and number of irrigators will improve irrigation management and reduce nutrient leaching.

The applicant leases part of the Tiroa E block on which the plant and effluent storage pond are situated. This lease is due to expire on 30 September 2019.

Before the lease is renewed (and while it is uncertain whether the plant will continue operating after September 2019) Crusader Meats does not propose to significantly increase production or effluent volumes, or invest in major upgrades to effluent storage and treatment. Proposed improvements to reduce environmental effects during this period include increasing the daily irrigation volume when soil conditions are suitable to receive the effluent, irrigation of supplementary water during dry periods, and other practices outlined in the attached Irrigation Management Plan.

Within 18 months of the lease on the Tiroa E Block being renewed, the applicant proposes to increase effluent storage capacity as described in the Pond Storage section below.

Before any significant increase in effluent production above current levels, which would not occur until after the lease is renewed, the applicant proposes to:

- Further increase effluent storage capacity as required (discussed in the Pond Storage section below).
- Increase the area of land to which the effluent is applied.

The latter would be achieved by fencing and planting the wetland areas adjacent to sites H9-H13, to enable irrigation to commence on these sites. The commencement of irrigation on these sites would increase the area of irrigated land by 24% (28.5 ha).

Until these upgrades are implemented, it is proposed that the 28-day moving average daily volume of effluent irrigated (excluding supplementary water irrigated during dry periods – refer Section 3.2.8 of Irrigation Management Plan) shall not exceed 900 m^3/day.

With respect to improving the quality of effluent irrigated, potentially the nitrogen and phosphorus content of the wastewater could be reduced by various means.

Nitrogen can be reduced biologically by converting the nitrogen to nitrogen gas in aerobic and anoxic treatment ponds or tanks. A portion of the wastewater nitrogen can also be removed as sludge in a physiochemical treatment system. Phosphorus can also be removed biologically and by chemical precipitation. However, nutrient removal technologies have high capital and operating costs. This approach is unlikely to be cost-effective or the best practicable option while there is sufficient land available to irrigate up to 50% more wastewater than currently produced, within the proposed sustainable nitrogen application limit of 200 kg/ha.year.

In addition to high costs, pre-treating the wastewater to reduce nutrients can have disadvantages for beneficial use of the remaining nutrients applied to land. For example, biological nitrogen removal involves aerobic treatment which converts ammonia to nitrate, which, when applied to land is much more prone to leaching than the ammonia and organic nitrogen applied in anaerobically treated effluent.

As outlined above and discussed further below, we consider that the best practicable option for accommodating any future increase in effluent production at the site, without increasing nutrient leaching, is to increase available storage and optimise the use of the available land area.

Pond Storage

Please advise the number of day's available for emergency storage of wastewater and how the proposed increase of wastewater will be managed, given there currently appears to be limited storage available.

The effluent pond has approximately 5,000 m^3 of effective storage capacity. The pond allows for up to 5.5 days of emergency effluent storage at the current maximum daily volume of 900 m^3 per day, or about 8.5 days on average. The pond level is operated as low as possible to maximise the available storage capacity. Further details of how the available storage is managed are set out in Sections 2.2, 3.11, 3.14 and 3.23 of the attached Irrigation Management Plan.

We have used the software *Dairy Effluent Storage Calculator (DESC) version 1.46* to estimate effluent storage requirements for Crusader Meats' current monthly average effluent volumes (as measured for the period 1 May . Two scenarios were modelled:

- Scenario A: Current 900 m³/day irrigation volume.
- Scenario B: Proposed 1,500 m³/day irrigation volume.

The inputs and outputs of this modelling are reported in Appendix 5, and the main outputs are summarised in Table 7.

Table 7
Storage volumes calculated by *Dairy Effluent Storage Calculator 1.46* for Crusader Meats' current effluent volumes.

	Scenario A	Scenario B	Reduction
90% probability storage volume (m³)	21,618	12,108	44%
100% probability storage volume (m³)	30,634	20,430	33%

The results show that, for current effluent production volumes, increasing the daily irrigation volume from 900 m³ to 1500 m³ would reduce the required storage volume by up to 44%. Less storage is required because more effluent can be irrigated when soil conditions are most suitable to receive the effluent.

The proposed increase in the maximum daily effluent volume will therefore significantly improve the effectiveness of the existing storage capacity in maximising the nutrient and water value of the effluent.

The DESC modelling also shows that the existing storage is less than recommended. Even with careful management of pond levels, at times it is necessary to irrigate wastewater when soil moisture conditions are not ideal.

Within 18 months of renewing its lease on the Tiroa E Block, the Applicant proposes to increase the effluent storage capacity to at least the DESC 90% probability volume. It is also proposed to install further capacity as may be required with any future increase in production at the site to maintain compliance with the DESC 90% probability storage volume.

Before the lease is renewed, while it is uncertain whether the plant will continue operating after September 2019, it is not a practicable option for Crusader Meats to invest in upgrading the effluent storage capacity. The *Best Practicable Option* in the meantime is to increase the daily irrigation volume limit to improve the effectiveness of the existing storage system. Also, as mentioned above, until additional storage is installed, the applicant proposes no significant increase in effluent production above current volumes.

Water Use

Please clarify whether or not water use requirements have changed given the company is not using all the water currently consented under resource consent 104934.

The consented groundwater take volume of 1,500 m³ per day allows for an increase in production at the site. An increase in production has not yet occurred because of uncertainties around renewal of the lease. The 1,500 m³ daily volume also allows for the proposed irrigation of supplementary water during dry periods, to enhance plant uptake of the nutrients applied in the effluent, as described in Section 3.2.8 of the Irrigation Management Plan.

Odour Effects

Please provide further detail regarding how odour will be managed on the property, particularly with the proposed increase in wastewater to be discharged to ensure there is no offensive or objectionable odour beyond the property boundaries. Please provide this information in the Management Plan requested above.

The management of potential odour effects from the anaerobic pond and land application activities is described in sections 3.1.3, 3.2.11, 3.3.3 and 6 of the Effluent Irrigation Management Plan.

Please also note that any future increase in effluent production will require an increase in effluent storage volume, which will provide additional treatment of the wastewater and reduce its potential to emit odour during irrigation.

Intensive Farming

In addition to the above, please note that if you are irrigating to new land, you may require a land use consent for new Intensive Farming. If this is the case, you should apply for this concurrently with this application.

No land is proposed to be irrigated that is not already consented for effluent irrigation. A land use consent for new Intensive Farming is therefore not required.

We trust the information supplied meets your requirements. Please do not hesitate to contact me should you require further information or clarification.

Yours sincerely

Albert van Oostrom
Principal

Appendix 1. Effluent Irrigation Management Plan

Crusader Meats New Zealand Ltd

Effluent Irrigation Management Plan

Issue 2

22 August 2016

Contents

1 Introduction

1.1 Background

F J Ramsey (Trading) Limited and Crusader Meats New Zealand Limited (collectively known as Crusader Meats) own and operate a meat processing plant on State Highway 30, approximately 10 km east of Benneydale.

Process wastewater from the plant is screened to remove large particles, pumped to a storage pond and then irrigated onto two properties (Tutaki and Te Hape B Blocks) south of State Highway 30. Slurry wastes (from the yards and the effluent pond) are spread on parts of the Tutaki Block. A portion of the slurry waste is proposed to be spread on parts of the Tiroa E block adjacent to the plant.

1.2 Resource Consents

The discharge of processing wastewater and yards' solids onto land is authorised by resource consents 100696 and 100926, which were granted on 22 May 2001. Consent number 100696 applies to the Te Hape B/Tiroa E blocks and 100926 applies to the Tutaki block. Both consents share the same conditions and in practice are treated as one consent. A copy of the consent is attached in Appendix 1.

Number	Type	Authorised activity
100696 & 100926	Discharge to land	Discharge meatworks effluent onto and into land on the Te Hape B Block, Tiroa E Block and Tutaki Block for a term expiring on 22 May 2016.

An application for replacement resource consents was lodged on 22 February 2016.

Minor changes to consent conditions and the management plan are proposed. These proposed changes are included in this document and identified by blue text and/or described as "proposed".

1.3 Scope and Purpose

This management plan has been prepared to fulfil the requirements of consent condition 8, as follows.

Cond.	Requirements
8	The effluent irrigation regime shall be managed according to an Effluent Irrigation Management Plan approved by horizons.mw with regard to the maintenance of buffer zones, riparian planting, stock management, storage pond capacity, daily and monthly monitoring of the irrigation system and water quality and soil testing.

The Effluent Irrigation Management Plan describes the procedures that shall be followed to ensure compliance with the conditions of the resource consent.

1.4 General Responsibilities

The **Plant Manager** has overall responsibility for the operation of the wastewater irrigation system and compliance with the resource consent.

The **Irrigation Operator** is responsible for the day-to-day operation of the wastewater irrigation system, including setting up irrigators and monitoring to prevent runoff and ponding.

2 Description of Wastewater Treatment System

2.1 Wastewater Sources and Primary Treatment

A schematic of water and wastewater flows at Crusader Meats is shown in Figure 1.

Wastewater from the plant derives from a range of sources including the stockyards, a truck wash, slaughtering, boning, offal processing and skin washing. Stormwater catchment areas that have potential to become contaminated also drain to the effluent system.

The untreated wastewater from the plant contains small quantities of blood, fat, meat scraps and biodegradable detergents from the processing areas, salt from preserving skins, and animal faeces and urine from the stockyards, truck wash and gut washing operations.

The wastewater from the stockyards and truck wash passes through a sedimentation tank (Figure 2) which removes most of the large solids from this effluent. The manure solids are removed from the sedimentation tank weekly and applied to land using a slurry spreader.

All of the wastewater from the processing areas passes through a 0.5 mm wedge-wire screen (Figure 2), which removes most of the solid particles from the wastewater. These solids, together with offal and blood, are trucked off-site to be processed into by-products.

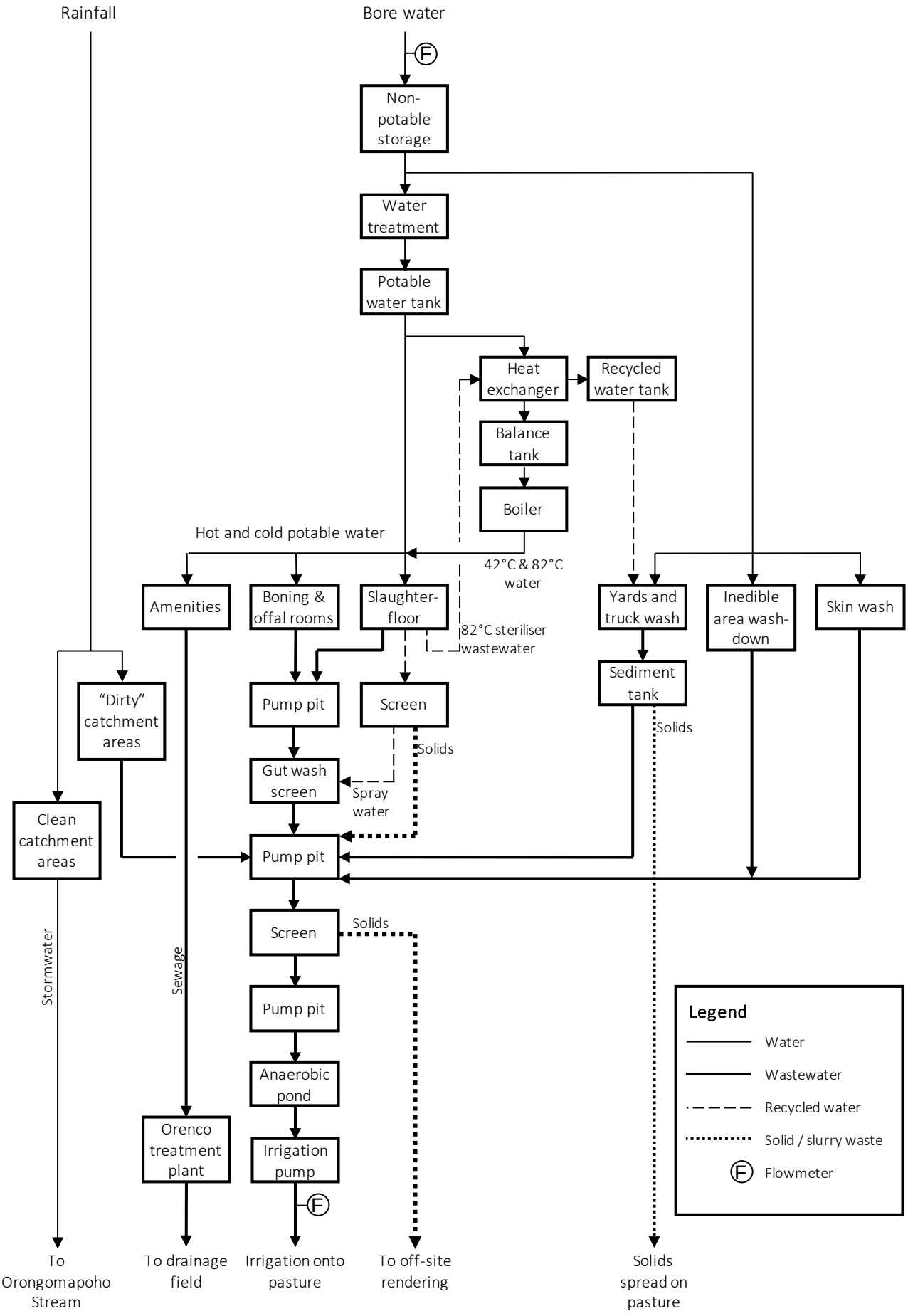


Figure 1

Schematic of water and waste flows.

Figure 2

Stockyards wastewater sedimentation tank (left) and main wastewater screen (right).

2.2 Storage Pond

The screened wastewater is pumped to an anaerobic storage pond (Figure 3) located approximately 350 m northwest of the plant (refer to site plan in Appendix 2).

The pond is 70 m long by 40 m wide and has a depth of 4.6 m. The total volume is 7,000 m³. The minimum and maximum operating volumes are approximately 1,200 m³ (1.5 m depth) and 6,200 m³ (4.3 m depth) respectively, giving an effective storage capacity of approximately 5,000 m³.

The pond provides anaerobic treatment of the wastewater and enables wastewater to be stored during wet weather and machinery breakdowns, when irrigation of the normal daily wastewater volume is not possible.

The pond allows for up to 5.5 days of wastewater storage at the current maximum production rate of 900 m³ per day, or about 8.5 days on average. The pond level is operated as low as possible to maximise the available storage capacity.

Figure 3
Anaerobic pond, installed in 1999.

The pond is lined with a 1.5 mm high density polyethylene (HDPE) geomembrane. Beneath the liner is a leak detection system consisting of a network of underdrains with an exposed outlet at the base of the pond's southern embankment.

The pond removes organic matter from the wastewater by anaerobic biological processes as well as by physical mechanisms such as sedimentation of solids. The biological treatment processes produce biogas (a mixture of mainly methane and carbon dioxide), which is emitted to the atmosphere.

A high organic loading on this pond maintains a stable crust (Figure 4), which effectively filters the odour from the emitted biogas.

The pond outlet consists of a pivoting pipe suspended from floats. The outlet level rises and falls with the level of the pond. The outlet position is set just below the crust to remove the clear water between the crust and pond sediment. This minimises the carry-over of solids into the irrigation system and the blockage of irrigator nozzles.

Every two years during the annual plant maintenance shutdown, the pond is cleaned out by mixing the crust and sediment into a slurry and irrigating the slurry onto selected paddocks using a rain-gun irrigator.

Figure 4
Anaerobic pond maintains a stable crust for odour control.

2.3 Effluent Irrigation

2.3.1 Irrigation Sites

Details of the land application sites are shown on the site plan attached in Appendix 2 and in Table 1. The land treatment sites are all managed as dry-stock-grazed pasture.

The total area currently available for the land treatment of wastewater and slurry wastes is approximately 177.7 ha (Table 1). This is the net area of irrigable land available. It excludes the area of required buffer zones and areas that are too steep or inaccessible for land treatment.

An additional 4.9 ha site (H102) is proposed to be used for slurry application, to give a total land application area of 182.6 ha (Table 1).

One site (H101, formerly H15) is currently only available for emergency use and is proposed to be used for slurry application.

The land suitable for waste application is divided into 40 sites: 32 for wastewater irrigation and eight designated for slurry application. Sites mostly correspond with individual paddocks, but in some cases they are defined by a contiguous area of irrigable land spanning two or more paddocks.

The separation of land treatment areas into irrigation sites and slurry spreading sites is for convenience and ease of management. As required, slurry areas could be used for wastewater irrigation, and vice-versa, but wastewater and slurry shall not be applied to the same area at the same time.

Table 1 Existing and proposed areas for wastewater and slurry application.					
Activity	Block	Site	Area (ha)	N load* (kg/year)	Status
Wastewater irrigation	Te Hape B	H3	6.2	1240	Existing
		H4	5.0	1000	Existing
		H5	4.5	900	Existing
		H6	0.7	140	Existing
		H7	2.9	580	Existing
		H8	4.2	840	Existing
		H9	4.2	840	Existing but not yet used. Fencing and planting of adjacent wetlands is required before commencing irrigation.
		H10	6.0	1200	
		H11	2.8	560	
		H12	3.2	640	
		H13	5.5	1100	
		H14	6.8	1360	Existing
		Total	52.0	10400	
	Tutaki	T1	8.8	1760	Existing. Area revised
		T2	1.4	280	Existing. Area revised
		T3	4.6	920	Existing. Area revised
		T4	4.9	980	Existing. Area revised
		T5	4.1	820	Existing. Area revised
		T6	2.9	580	Existing
		T8	1.6	320	Existing
		T10	3.0	600	Existing. Area revised
		T11	2.2	440	Existing
		T12	7.6	1520	Existing
		T13	5.0	1000	Existing
		T14	2.1	420	Existing
		T15	3.4	680	Existing
		T16	1.8	360	Existing
		T17	11.0	2200	Existing
		T18	6.6	1320	Existing
		T19	5.0	1000	Existing
		T20	0.6	120	Existing
		T21	11.1	2220	Existing
		T22	9.9	1980	Existing
		Total	97.6	19520	
	All blocks	**Total**	**149.6**	**29920**	
Slurry spreading	Tiroa E	H101	14.3	2860	Existing site H15 for emergency irrigation use. Proposed for slurry spreading. Area revised
		H102	4.9	980	New
		Total	19.2	3840	
	Tutaki	T101	0.2	40	Existing
		T102	0.4	80	Existing
		T103	2.3	460	Existing
		T104	1.5	300	Existing
		T105	6.5	1300	Existing
		T106	2.9	580	Existing
		Total	13.8	2760	
	All blocks	**Total**	**33.0**	**6600**	
All activities	Te Hape B/Tiroa E	Total	71.2	14240	
	Tutaki	Total	111.4	22280	
	All blocks	**Total**	**182.6**	**36520**	

*Nitrogen load that can be applied based on an application limit of 200 kg N/ha.year.

2.3.2 Reticulation

Wastewater from the anaerobic pond is pumped to irrigation areas on the Tutaki and Te Hape Blocks through a network of buried pipes, as shown on the site plan (Appendix 2).

The pump is located near the Contra Shear screen at the plant. A flowmeter on the pump discharge measures the volumes of effluent irrigated.

The pipeline crosses the Orongomapoho and Waimiha Streams to the irrigation sites of the Te Hape Block and then crosses the Waimiha Stream again to the Tutaki Block.

Sixteens hydrants for connection of irrigators in the Te Hape block are labelled “A” to “P” on the site plan. Hydrants “J” to “P” are in the vicinity of the Miringa Te Kakara Marae. This part of the reticulation system has been isolated with a valve and is no longer used because of its proximity to the Marae. Hydrants A and B are also no longer used.

Heavy duty portable hoses are used to extend the reach of the buried reticulation system into all of the irrigable areas.

2.3.3 Irrigators

The wastewater is irrigated using 90 K-Line sprinkler pods (Figure 5).

There are 18 irrigation lines, each consisting of five sprinklers spaced 15 m apart along a length of 40 mm polyethylene pipe. Each sprinkler is contained inside a plastic “pod” that keeps the sprinkler upright and protects it from damage.

The rotating sprinklers are fitted with 3 mm diameter nozzles and provide an application rate of approximately 2 mm per hour.

The irrigation lines are moved by quad bike within and between irrigation sites on a rotational basis.

Figure 5
K-Line irrigation system.

2.4 Slurry Application

2.4.1 Manure Slurry

The manure slurry from the yards' sedimentation tank is applied to sites T101-T106 in the Tutaki Block using a 4,700 L slurry spreader (Figure 6). These sites have a total area of 13.8 ha. Site T105 and part of an adjoining block (7.5 ha in total) are reserved for application of pond slurry every second year, reducing the available area for manure slurry spreading to 6.3 ha in these years.

Figure 6
4700 L slurry spreader.

It is proposed to apply at least a portion of the manure slurry to two new sites adjacent to the plant (H101 and H102 – refer site plan, Appendix 2). This will reduce the time involved in carting the slurry, facilitate more frequent cleaning of the sedimentation tank, reduce the average nitrogen application rate and allow for possible increases in plant production.

2.4.2 Pond Slurry

Approximately 2,000 m³ of pond slurry is applied to 7.5 ha of land (usually site T105 and part of an adjoining slurry application site) every second year with a rain gun irrigator during the annual maintenance shutdown.

It is proposed that pond slurry be permitted to be applied to H101 (formerly H15) near the processing plant.

3 Management and Operating Procedures

3.1 Effluent Pond

3.1.1 Level Control

The level of the pond shall be checked daily to assess available storage capacity.

The irrigation shall be managed such that the level in the pond is kept as low as possible to maximise storage capacity. Maximising storage capacity enables the plant to continue operating during wet weather and irrigation system breakdowns, when the normal daily effluent volume cannot be irrigated.

3.1.2 Leak Monitoring

The outlet of the leak-detection drains under the pond shall be checked weekly for flowing water that may indicate that the pond liner is leaking.

If the flow from the leak detection drains is significant, or if any flow is discoloured or odorous, a sample of the water shall be tested for ammoniacal nitrogen and total oxidised nitrogen as soon as possible.

If the drainage water contains effluent, actions shall be taken to contain the leakage and repair the liner as soon as practicable. The Regional Council shall be notified as soon as practicable after any leakage is confirmed.

3.1.3 Odour Control

Anaerobic ponds can be odorous, particularly if the wastewater contains a high load of sulphur-containing compounds such as sulphates and sulphides. In the New Zealand meat processing industry, anaerobic ponds that have caused odour problems have generally been those treating rendering plant wastewater containing high loadings of sulphur and fats.

The main sulphur-containing chemical used on site is sulphuric acid, which is used for stabilising offal before transport to an off-site rendering plant. The quantity that enters the effluent stream is minimal.

The quantity of sulphuric acid or any other sulphur-containing chemical that enters the effluent stream shall be kept to a minimum.

The use of sulphur-containing chemicals in the plant shall not be significantly increased without first assessing potential effects on effluent system odour, and taking actions to control odour as required.

A high organic loading on the pond maintains a stable crust (Figure 4), which effectively filters the odour from the emitted biogas. A stable crust naturally develops within a few weeks of the pond being cleaned out.

If a stable crust does not establish naturally, causing odour from the pond to become a nuisance, actions shall be taken the promote a stable crust. These actions may include spreading straw over the surface of the pond and installing floating baffles to stabilise the crust against the effects of wind.

3.1.4 Solids Removal

Excess solids shall be removed from the pond before they significantly reduce storage capacity or cause frequent blocking of irrigator nozzles.

The cleanout involves removing the clear wastewater from the pond by irrigation, mixing the crust and sediment layers into a slurry with a tractor mounted mixer, adding clean water as required to facilitate pumping, and irrigating the slurry onto selected paddocks (refer Section 3.3.3).

3.2 Effluent Irrigation

3.2.1 General Operating Procedure

- After an irrigation event has completed, each irrigation line shall be moved to a new location within the same irrigation site or to a new irrigation site that meets the following criteria:
    - The site is not due to be grazed for at least 7 days.
    - The site has not been irrigated (on a previous rotation) for at least 21 days.
    - After irrigating the site, the cumulative nitrogen loading over the last 12 months will not exceed the maximum permitted nitrogen application rate of 200 kg N/ha.year. (refer Section 3.2.6)
- Within a site, irrigators shall be distributed as evenly as possible with minimal overlap between irrigators (refer Section 3.2.4).
- The location of irrigators shall meet the buffer distances and other requirements described in Section 3.2.2.
- After shifting the irrigators, and subject to suitable weather and soil conditions (refer Section 3.2.5), and sufficient wastewater in the pond, the irrigation pump is restarted. Normally the Irrigation Operator radios the plant to start the pump.
- After the irrigation pump is started the following actions are taken:
    - The pump start date and time are recorded.
    - The number of irrigators in each site are recorded.
    - The pump speed is adjusted, if necessary, to the required flow rate and pressure (refer Section 3.4).
    - After the flow rate has stabilised, the flow rate is recorded and a timer is set to run the pump for a period that results in the required irrigation volume (refer Section 3.2.3).
    - The pump timer setting is recorded.
    - The pipeline failure sensing system is activated (refer Section 3.4).
    - The irrigators are inspected to ensure that required buffer distances have been met. If the position of an irrigator is not correct, it shall be moved immediately. This can be done while the pump is running by temporarily isolating the irrigator with the valve at the hydrant.

- The irrigators are inspected at least three times during each irrigation event to ensure there is no runoff or ponding.

3.2.2 Irrigator Siting and Buffer Zones

- The irrigators shall be operated only within the specific areas (sites) shown on the site plan in Appendix 2.
- The irrigators shall be located to ensure that the irrigator spray is kept at least:
  - 20 m away from any streams, wetlands or low areas likely to flood in wet weather, drains, stock water troughs and tomo.
  - 90 m from dwellings.
- The wind conditions shall be considered in siting irrigators to avoid spray drift into buffer zones.
- For irrigation sites H3, H4, T1, T2 and T4, the buffer zone adjacent to the Waimiha Stream has been fenced to prevent stock from damaging the vegetative cover, thus minimising the risk of any runoff crossing the buffer zone and entering the stream.
- Before irrigation commences in sites H9-H13, adjacent wetland areas as identified in Appendix 2 shall be fenced and planted.
- If an irrigation line must cross a swampy area or pass through a buffer zone the nozzles of the sprinklers within or near these areas shall be blanked off to ensure wastewater is not applied within the buffer zone.
- The topography and potential for runoff shall be considered when locating irrigators. Irrigators shall not be placed on steep sidings. However, relatively steep sidings can be safely irrigated by placing an irrigation line along the top of the siding or ridge and allowing approximately half of the irrigated wastewater to spray down the siding – so long as buffer zone requirements are met and runoff is avoided.

3.2.3 Irrigation Volume

The volume of wastewater irrigated shall not exceed 900 m^3 per day (Condition 1).

It is proposed that the maximum daily effluent irrigation volume be increased to 1,500 m^3. No increase in the application rate or depth is proposed. To achieve higher daily irrigation volumes will require a proportionate increase in the number of irrigators. To irrigate 1,500 m^3/day of effluent would require the number of K-line irrigation sprinklers to be increased from 90 to 150.

It is also proposed that the 28-day moving average daily volume of effluent irrigated (excluding supplementary water irrigated during dry periods – refer Section 3.2.8) shall not exceed 900 m^3/day without increasing effluent storage capacity to at least the 90% probability storage volume estimated by the Dairy Effluent Storage Calculator.

This proposed limit effectively prevents any significant increase in the volume of effluent produced by the plant until additional storage is installed.

The irrigators are normally shifted once a day. After the irrigation pump is started and the flow rate has stabilised, the flow rate is recorded and a timer is set to run the pump for a period that results in an application volume of between 860 and 900 m³. The flow rate currently varies between 38 and 53 m³ per hour, depending on the distance of the irrigators from the plant, their elevation, and the pump speed setting. The pumping hours typically range between 17 and 23.5 hours per day to achieve the desired irrigation volume.

The pumping duration is calculated using Equation 1.

$$T = \frac{V}{Q}$$ Equation 1

Where:

T is pumping duration (hours)
V is the volume of wastewater to be irrigated (m³)
Q is the flow rate (m³/hour)

3.2.4 Hydraulic Application Depth

The hydraulic loading rate shall not exceed 50 mm per day (Condition 13).

The hydraulic loading or application depth is largely controlled by the size of the sprinkler nozzles and spacing of the sprinklers. The sprinklers are spaced at approximately 15 m centres within and between irrigation lines, which results in minimal overlap between the spray radius of adjacent sprinklers.

The application depth can be determined by Equation 2.

$$D = \frac{V \times 1000}{N \times d1 \times d2}$$ Equation 2

Where:

D is the application depth (mm)
V is the volume of wastewater irrigated (m³)
N is the number of sprinklers
$d1$ is distance between sprinklers along an irrigation line (m)
$d2$ is the distance between irrigation lines (m)

Irrigation of 900 m³ of effluent via 90 sprinklers spaced 15 m apart results in an application depth of 44.4 mm (or 44 L/m²), which complies with the maximum permitted application depth of 50 mm.

The hydraulic application rate can be calculated using Equation 3.

$$R = \frac{D}{T}$$ Equation 3

Where:

R is the application rate (mm/h)

D is the application depth (mm)

T the pumping duration (hours)

if 900 m³ of wastewater is irrigated over 17 hours, the average application rate would be 2.6 mm/hour. If the same volume is irrigated over 23 hours, the average application rate would be 1.9 mm/hour.

3.2.5 Runoff and Ponding Control

In accordance with Condition 11, there shall be no ponding as a result of irrigation and no surface run-off of effluent to any water course or wetland area.

During each irrigation event the irrigators shall be inspected at least three times. In the event of any runoff or ponding, one or more of the following actions shall be taken, as appropriate:

- Shift the specific irrigators causing the runoff or ponding.
- Turn off the irrigation pump and recommence irrigation when soil moisture conditions are suitable.
- If runoff into a wetland or watercourse has occurred, prepare an incident report (refer Section 3.4).

The effluent pond level shall be kept as low as practicable by maximising the volume of wastewater irrigated during periods when soil moisture and weather conditions are most suitable for irrigation. Maintaining the pond as low as possible minimises the need to irrigate wastewater when soil moisture conditions are not ideal for irrigation.

Irrigation during rainfall and onto saturated soil shall be avoided as far as practicable.

3.2.6 Nitrogen Application

The nitrogen application rate shall not exceed 200 kg N/ha/year (Condition 13).

Methods for calculating and monitoring nitrogen loadings are described in Section 4.3.

3.2.7 Stock Management

Irrigation sites shall not be grazed during irrigation and for at least 7 days following effluent application. This requirement minimises risks to stock health.

The irrigation activities shall be coordinated with the farm managers of the Te Hape B, Tiroa E and Tutaki blocks.

3.2.8 Irrigation of Supplementary Water (Proposed)

During dry periods in summer, plant growth is limited by soil water rather than available nutrients. When the soil water deficit is greater than 50 mm and significant rainfall is not forecast within the next week, it is proposed to dilute the irrigated effluent with supplementary water (subject to water availability and pumping capacity) to promote plant growth and enhance plant uptake of the effluent nutrients.

The total volume of effluent and supplementary water irrigated shall not exceed 1,500 m^3/day, and the use of supplementary water shall not cause the daily groundwater take to exceed 1,500 m^3/day (refer Consent 104934).

It is proposed to feed supplementary water at a controlled rate into the wastewater stream on the suction side of the effluent irrigation pump via a backflow preventer and separate flowmeter. The volume and flowrate of supplementary water would be monitored to enable the irrigated effluent volume and nitrogen loading to be determined.

This method of enhancing nutrient uptake by plants relies on the proposed increase in the permitted daily irrigation volume to 1,500 m^3 (refer Section 3.2.3). No increase in the hydraulic application rate or depth per application is proposed. Therefore, during dry periods, the supplementary water would proportionately reduce the rotation period and the nitrogen application rate per rotation.

3.2.9 Maximisation of Nutrient Uptake

The wastewater is a valuable source of plant nutrients. Practices to optimise plant uptake and minimise nutrient leaching to groundwater include the following.

- Ensure compliance with nitrogen and hydraulic application limits.
- Ensure that ponding and runoff does not occur.
- Manage the available pond storage capacity to minimise irrigation when soil moisture conditions are not ideal.
- Distribute the wastewater as evenly as practicable within and between the irrigation sites, maintaining required buffer zones.

- Maximise the use of cut-and-carry silage production, where the silage produced is sold or fed out onto non-irrigated areas of the farms. Within permitted limits, maximise effluent applications to paddocks used for cut-and-carry silage production.
- During dry periods in summer, when the soil water deficit is greater than 50 mm and significant rainfall is not forecast within the next week, dilute the effluent with any available supplementary water to enhance plant uptake of nutrients (refer to Section 3.2.8).

3.2.10 Summary of Proposed Changes to Effluent Irrigation Practices

The main change proposed for this activity is an increase in the consented maximum daily volume of wastewater discharged from 900 m^3 to 1500 m^3, to

- Match the consent bore water take volume.
- Allow for increased operational flexibility and a possible increase in production at the site.
- Enable irrigation of supplementary water during dry periods in summer when a lack of water limits nutrient uptake by plants.

An increase in the discharge volume will involve applying the wastewater via more irrigators. No increase in the application rate or depth is proposed.

The ability to irrigate a greater daily volume of wastewater gives more flexibility in the timing of irrigation without increasing any environmental risks.

Another change is that existing irrigation site H15, currently reserved for emergency wastewater application, is proposed to be used for applying slurry wastes.

3.2.11 Odour Control

Although the anaerobically treated wastewater has an odour that is detectable downwind of paddocks being irrigated, the irrigation sites are sufficiently far from roads and dwellings that any odour effects should be less than minor.

Irrigation shall not be undertaken within 90 m of any dwelling, including the house adjacent to irrigation site H3.

Should there any odour complaints associated with the irrigation these complaints shall be logged and actions taken in accordance with the procedure outlined in Section 6.

For the irrigation, these actions may include the following:

- Identify any changes in practices that may have caused any increase in odour and undertake remedial action as appropriate.

- If the complaint is about current odour from the irrigation, cease irrigation and move the irrigators to another location that avoids any odour nuisance, or wait until wind conditions are suitable before resuming irrigation.

3.3 Slurry Application

3.3.1 General

The application of manure slurry and effluent pond slurry to land shall not exceed a nitrogen application rate of 200 kg N/ha.year.

The slurry shall be applied only to sites designated for slurry spreading as shown on the site plan in Appendix 2. The slurry shall be applied as evenly as practicable within and between available spreading sites.

The slurry shall not be spread within 20 m of any streams, drains, wetlands or low areas likely to flood in wet weather.

The date, application site and volume of slurry applied shall be recorded and the application depth shall be managed to ensure that the nitrogen application rate does not exceed 200 kg N/ha.year.

Because most of the nitrogen in the slurry wastes is in the form of organic nitrogen (such as proteins) the 200 kg N/ha.year nitrogen loading limit can be safely applied in a single application without risk of excessive nitrogen leaching.

The application depth equivalent to a nitrogen application rate of 200 kg N/ha.year can be calculated using Equation 4:

$$\boldsymbol{D = \frac{20000}{N}} \qquad \text{Equation 4}$$

Where:

D is the application depth (mm)

N is the slurry nitrogen concentration (g/m³)

The minimum required application area can be calculated using Equation 5:

$$A = \frac{V}{D \times 100} \qquad \text{Equation 5}$$

Where:

A is the application area (ha)

V is the volume of slurry to be spread (m³)

D is the maximum application depth (mm)

3.3.2 Manure Slurry

The nitrogen application rate for manure shall be estimated as 12 kg of nitrogen per 4,700 L load of slurry (2,553 g N/m³ of slurry). At this nitrogen concentration, a nitrogen application rate of 200 kg/ha.year equates to an application depth of 7.8 mm or spreading one 4,700 L load of slurry over and area of 600 m².

The nitrogen content of the manure slurry used for determining the application rate may be revised by testing at least three representative samples of the slurry for total nitrogen and averaging the results.

3.3.3 Pond Slurry

Any irrigation of pond slurry in proposed new slurry application areas H101 and H102 shall not occur within 100 m of State Highway 30 as a precaution to avoid potential odour effects.

The pond slurry typically contains around 700 g/m³ of total nitrogen. For this concentration, the total application depth shall not exceed 28 mm to ensure compliance with the nitrogen application limit of 200 kg/ha.year (refer Equation 4).

The nitrogen content of the pond slurry used for determining the application rate may be revised by testing three representative samples of the slurry for total nitrogen and averaging the results.

To avoid runoff and ponding, the slurry shall be applied in two or more applications with a resting period between applications.

The irrigation of pond slurry shall be closely monitored to ensure that the buffer zones are maintained and there is no runoff into water courses or leakage from the reticulation pipelines.

The application rate of the rain gun irrigator can be calculated as follows:

$$R = \frac{Q \times 1000}{3.142 \times r^2}$$ Equation 6

Where:

R is the application rate (mm/h)

Q is the pumping rate (m³/h)

r is the spray radius of the irrigator (m)

The maximum total time that the irrigator may operate at any location can be calculated as using Equation 7.

$$T = \frac{D}{R}$$ Equation 7

Where:

T the maximum hours an irrigator shall operate in any one location

D is the maximum application depth (mm)

R is the application rate (mm/h)

Pond slurry and manure slurry shall not be applied to the same site within any 12-month period.

Paddocks shall not be grazed within 28 days of receiving an application of pond slurry.

3.4 Reticulation System Integrity and Spill Contingency

Consent Conditions 14 and 15 specify spill contingency requirements as follows:

Cond.	Requirements
14	This permit does not authorise emergency discharges of effluent under any circumstances. The Permit Holder shall provide sufficient additional storage and/or have contingency management procedures in place to ensure unauthorised discharges of effluent do not occur due to wet weather surcharge flows, equipment malfunction or any other foreseeable cause.
15	The Permit Holder shall install and maintain an automatic shut-off valve that will stop the flow of effluent in the event of irrigation pipe rupture or significant leakage.

The following precautions shall be taken to minimise the risk of effluent spillage and leaks.

- The pressure in any part of the effluent/pond slurry reticulation system shall not exceed the rated pressure of the pipeline.
- The reticulation pipework including pipe bridges shall be maintained in good condition and inspected at least once a month for leaks.
- Irrigators shall be inspected at least three times a day while operating.

- A flow-sensing switch shall be operated and maintained to automatically turn off the effluent irrigation pump and trigger an alarm if there is major failure in the irrigation pipe network. This sensing system shall be activated once the flow rate has stabilised following pump start-up and shall automatically shut down the pump if the flowrate increases by more than 10%.

If the pump shutdown switch activates, the reticulation system shall be inspected before restarting the pump, unless there is good reason to believe no pipe failure has occurred.

On discovery of a pipeline rupture or significant leakage, the following actions shall be taken:

- Shut down the pump immediately if it has not already shut down automatically.
- As far as practicable contain any spillage to prevent or minimise any discharge into a wetland or water course. For example, using a shovel or front-end loader dig a channel or construct earth bunds to divert or contain the wastewater.
- Assess the flowrate and volume of leakage and determine whether there has been an unauthorised discharge into a stream or wetland.
- Repair the fault as soon as practicable.
- Prepare a report on the incident including an assessment of the volume discharged and the actions taken to minimise the discharge.
- Notify the Regional Council of the incident as soon as practicable.

4 Monitoring

4.1 General

Monitoring is necessary to manage the wastewater treatment system and ensure compliance with consent conditions.

Minimum monitoring requirements are set out in Consent Conditions 16 to 18. Procedures are detailed below.

4.2 Environmental Log

To meet the requirements of Consent Condition 16, the following information shall be recorded for each irrigation event, including irrigation of pond slurry:

- The averge flow rate or total volume of wastewater irrigated.
- Start date and time for pumping.
- Total hours pumped.
- The sites irrigated.
- The number of irrigators in each site.

- Any equipment malfunctions relating to the wastewater system (e.g. pumps, pipelines) and details of repairs or remedial actions.

The following information shall be recorded daily:

- Minimum and maximum air temperatures.
- Rainfall.
- Wind direction and strength.
- Soil moisture conditions (wet / moist / dry).
- Pond depth.
- Water use.

Each time the manure pit is cleaned out the following information shall be recorded:

- Date.
- Application site(s).
- Volume of manure slurry spread on each application site.

4.3 Nitrogen Loadings

For each irrigation event, the nitrogen loading applied to each site is calculated from the volume of effluent applied to the site and the concentration of nitrogen in the effluent.

The total volume of effluent irrigated during each irrigation event may be determined by the flow rate and the number of pumping hours, or from flowmeter totalizer readings at the beginning and end of the irrigation event.

More than one site may be irrigated during an irrigation event. The volume applied to any one site during an irrigation event is calculated from the number of irrigators in that site as a proportion of the total number of irrigators operating during that event.

On a regular basis, the effluent nitrogen test results and irrigation records are entered into an Excel spreadsheet that calculates the nitrogen loading applied to each site and determines which sites are available to receive more wastewater without exceeding the nitrogen application limit.

The spreadsheet is used to monitor consent compliance and manage the effluent irrigation.

4.4 Effluent Sampling and Testing

In accordance with condition 17b, the characteristics of the wastewater from the storage pond shall be monitored as follows:

Frequency	Sample type	Parameters
Monthly	Composite of approximately four weekly grab samples	Total Kjeldahl Nitrogen (TKN) Chemical oxygen demand (COD)
Six monthly	Composite of approximately four weekly grab samples	Total phosphorus Total sodium Total calcium Total magnesium Total potassium

Samples shall be analysed by a suitably qualified laboratory.

The sampling procedure is as follows:

- Approximately four times a month at weekly intervals, collect a 250 mL sample of effluent via a sampling valve on the irrigation pump discharge. Before taking the sample, shut off any supplementary irrigation water and run effluent through the valve for a few seconds to flush out any solids that may have accumulated in the valve.
- Combine the four 250 mL weekly samples into a single 1-litre bottle containing about 0.8 mL of concentrated sulphuric acid. Cap the bottle and store in a refrigerator at 4°C. The acid and refrigeration are necessary to preserve the effluent.
- At the end of each month, place the bottle containing the four weekly samples in a chilly bin with ice pack, and send by courier to an approved laboratory.
- Include a completed sample submission form in the chilly bin to advise the laboratory of the source of the sample and the tests required.

The laboratory supplies the chilly bin, ice pack and sample bottles.

In anaerobic pond effluent, the Total Kjeldahl Nitrogen (TKN) concentration is equivalent to the total nitrogen concentration and shall be used to calculate the amount of nitrogen irrigated.

Chemical oxygen demand (COD) is a measure of organic matter and indicates how well the pond is breaking down the effluent organic matter.

Total phosphorus and potassium are monitored to estimate the loadings of these plant nutrients on the wastewater irrigation sites.

Sodium, calcium and magnesium are monitored six-monthly to determine the Sodium Adsorption Ratio (SAR). A high SAR (e.g. >10) can damage soil structure and reduce soil infiltration rate. Ideally the effluent SAR should be less than 5. The SAR is calculated using Equation 8.

$$SAR = \frac{\frac{Na}{23}}{\sqrt{\frac{Ca}{40} + \frac{Mg}{24.3}}}$$ Equation 8

Where:

SAR is the Sodium Adsorption Ratio

Na is sodium concentration (mg/L or g/m³)

Ca is calcium concentration (mg/L or g/m³)

Mg is magnesium concentration (mg/L or g/m³)

4.5 Effluent Pond Leakage

Refer to Section 3.1.2 for effluent pond leakage monitoring procedures.

4.6 Soil Sampling and Testing

Soil testing of the irrigation areas shall be undertaken in accordance with Condition 17c, as follows:

Cond.	Requirements
17c	Soil characteristics in the irrigation area. A soil-sampling programme is to be undertaken in November each year for the term of this permit. Three paddocks located in the effluent disposal areas and a control sample (a paddock not irrigated) shall be sampled. The paddocks sampled shall be varied in a rotation cycle each year to ensure that all paddocks receiving effluent are sampled over time. At least 20 cores shall be taken from each paddock at two depths, 0 - 10 and 10 - 20 cms. The samples shall be analysed for: PH Calcium Phosphorus Potassium Sulphate-sulphur Magnesium Sodium total nitrogen base saturation by a suitably qualified laboratory. The soil infiltration rate and the soil organic matter content shall also be measured in each of the paddocks sampled.

A proposed improved soil monitoring procedure is described below.

A soil-sampling programme shall be undertaken in November each year. The soil quality within twelve wastewater or slurry application sites shall be monitored: four sites in the Te Hape B/Tiroa E Blocks and eight sites in the Tutaki Block, including two sites receiving slurry applications. Four sites shall be sampled each year on a rotation cycle to ensure that each monitored site is sampled on average every three years. At least 20 soil cores shall be taken in each site at two depths: 0 - 10 cm and 10 - 20 cm. The samples shall at be taken at even intervals along a 190 m transect. The location of each end of the sampling transect shall be defined by GPS coordinates to enable the same transect to be sampled repeatedly. The samples shall be analysed for:

- pH
- Calcium
- Olsen P
- Potassium
- Sulphate-sulphur
- Magnesium
- Sodium
- Total nitrogen
- Base saturation
- Organic matter

Monitoring of soil infiltration is proposed to be discontinued.

4.7 Water Quality

The Waimiha Stream shall be sampled once per month in the months of January, May and September each year, at three sampling sites: Upstream, Midway and Downstream as shown on the site plan in Appendix 2.

On the same days that the Waimiha Stream is sampled, streams running through the Tutaki Block shall be sampled at four sampling sites labelled A, B, C and D, as shown in Figure 7.

Samples shall be collected into bottles provided by the laboratory and analysed for the following parameters:

- Total suspended solids (TSS)
- Total oxidised nitrogen (nitrite-nitrogen plus nitrate-nitrogen) (NOx-N)
- Total Kjeldahl nitrogen (TKN) [proposed to be replaced by total nitrogen (TN) with TKN calculated as TN - NOx-N - NH_4-N]
- Ammoniacal nitrogen (NH_4-N)

- Total phosphorus [not currently required by consent]
- Dissolved reactive phosphorus (DRP) [not currently required by consent]
- *E. coli*

Samples for *E. coli* analysis shall be collected into a sterile bottle. Use the following sampling procedure to avoid sample contamination:

- Open the bottle only for collection of the sample and then immediately replace the cap.
- Fill the sample bottle by dipping it in the water with the bottle mouth facing upstream.
- Do not touch the insides of the cap and bottle.

Label each sample bottle with date, time and sample source.

Place the samples in a chilly bin with an ice pack, and send by courier to an approved laboratory. Ensure that the samples are despatched in time for them to be received by the laboratory within 24 hours of sampling. Include a completed sample submission in the chilly bin to advise the laboratory of the source of the samples and what tests are required.

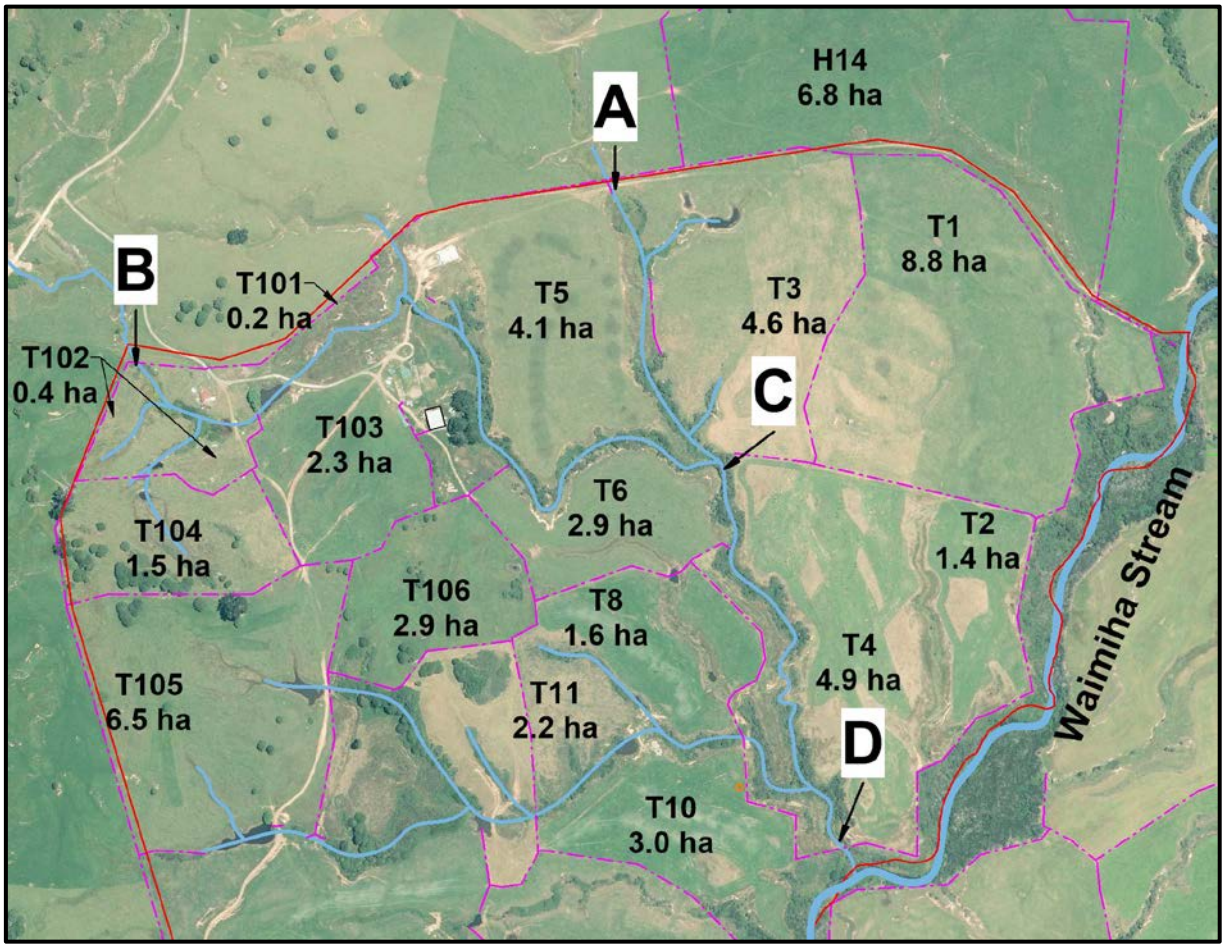


Figure 7

Proposed stream sampling sites in the Tutaki Block. Note that sample site C is downstream of the confluence of the streams sampled at sites A and B.

4.8 Nutrient Budget (Proposed)

A nutrient budget for the land application areas shall be prepared annually using OVERSEER, for the year to 30 June.

OVERSEER is a software application that supports farmers to make informed decisions about their nutrient use on-farm to improve performance and reduce losses to the environment.

OVERSEER model inputs to be recorded include:

- Supplements imported: date, type, quantity.
- Stock purchased: date, number, species, class, breed, age, sex, weight (if available).
- Stock born on farm: date, number, species, breed, sex.
- Stock sold: date, fate (to store or works), age, weight (if available).
- Monthly stock numbers.
- Wool production: date and weight.
- Cultivation and regrassing: date, pasture type, paddock(s).
- Supplements made: date, type, paddocks harvested, quantity, (e.g. number and size of bales or weight).
- Monthly supplements used on farm, sold, or in storage: number of bales or weight.
- Lime application: date, amount, paddock(s).
- Wastewater and slurry application details: as per Sections 4.2, 4.3 and 4.4.
- Soil test results: as per Section 4.6.

5 Reporting

5.1 Laboratory Test Results

In accordance with condition 17d, the results of soil, water and effluent testing shall be sent to the Regional Council's Team Leader Compliance within two weeks of the completion of the analyses.

5.2 Annual Report

An annual report shall be prepared to fulfil the requirements of Condition 18, as follows:

Cond.	Requirements
18	The Permit Holder shall prepare an annual report that includes the results of all monitoring of this resource consent and consents 100697, 100698 and 101365 and shall forward copies of the report to horizons.mw, Te Hape Marae and Miringi Te Kakara Marae by 30 June 2002 and by 30 June in every year thereafter for the term of this permit. The report shall include the following: i. summary of the monitoring results; ii. discussion of the implication of these results, iii. any incidences of non-compliance; and iv. any actual or proposed changes to the operational waste water storage and disposal procedures or Irrigation Management Plan.

Copies of the report shall be distributed to the parties identified in Condition 18 and also to the owners or Trustees of the Tutaki and Te Hape B/Tiroa E blocks.

It is proposed that the end of the annual reporting period be changed from 31 May to 30 June, and that the report submission date be 31 August. These changes align with the nutrient budgeting year and allow two months for preparation of the report.

5.3 Community Meetings

In accordance with Condition 19, a public meeting shall be held to discuss the content and implications of the annual report, if such a meeting is requested by any of the recipients within 1 month of receiving the report.

Cond.	Requirements
19	Within one month of receipt of the annual report required by Condition 18 of the Permit, the recipients of the annual report may request that the Consent Holder convene a public meeting to discuss the content and implications of the annual report.

6 Complaints Register

A complaints register shall be maintained to fulfil the requirements of Condition 23, as follows:

Cond.	Requirements
23	The Permit Holder shall maintain a complaints register. The register shall record: a. any public complaints it receives, and the time they were received; b. weather conditions including wind direction at the time of complaint; c. process operations and/or malfunctions at the time of complaint; and d. remedial measures or other action taken as a result of the complaint. The register shall be made available to horizons.mw staff on request.

The procedure for managing odour complaints is as follows:

1. Any public odour complaints shall be logged and investigated.
2. Record the following information in the complaints register:
    - Date and time of the complaint.
    - Wind strength and direction.
    - Complainant's name and contact details.
    - Location of the reported odour.
    - A description of the odour, including its frequency, intensity, duration, offensiveness (character) and location. Request this information from the complainant and add any further details resulting from the investigation.
    - Process operations and/or malfunctions at the time of the complaint.
    - A summary of the investigation undertaken and the likely source and cause of the odour.
    - Any remedial actions undertaken as a result of the complaint.
3. If the complaint is of a current odour event, visit the location of the reported odour to verify the odour and likely source.
4. As far as practicable, identify the cause of the odour and any action that may need to be taken to abate the odour (for current odour events) and prevent a similar incident recurring.
5. If the effluent pond is the likely odour source, undertake the following specific checks:
    - Odour intensity/offensiveness immediately downwind of the pond.
    - Sulphuric acid usage.
    - Have there been any relevant breakdowns?
    - The state of the crust on the pond.
6. If the effluent irrigation or slurry spreading activities are the likely odour source:
    - Identify any changes in practices that may have caused any increase in odour and undertake remedial action as appropriate.
    - If the complaint is about current odour from the irrigation, cease irrigation and move the irrigators to another location that avoids any odour nuisance, or wait until wind conditions are suitable before resuming irrigation.
7. Provide feedback to the complainant on the odour cause and any actions taken.

Appendix 1. Existing Consent 100696/100926

The Decisions

A. Discharge Permit 100696 and 100926

The Hearing Committee, acting under delegated authority under Section 34 of the Act, Grants **Discharge Permits 100696 and 100926** pursuant to Section 105(1)(b) of the Act to F J Ramsey Trading Ltd for the discharge of meatworks effluent onto and into land on the Te Hape B Block, Tiroa E Block and Tutaki Block for a term expiring on 22 May 2016, subject to the following conditions:

General

1. The maximum daily discharge of pond treated meat processing effluent and yard solids onto and into land depicted on Plan C100696 legally described as Te Hape B Block and Tiroa E Block and Tutaki Block shall not exceed 900 cubic metres ($900m^3$ per day).

2. The design, construction and maintenance of the necessary works associated with this permit shall be in accordance with the proposal as outlined in the application.

3. The design, construction and maintenance of the necessary works associated with this permit shall be carried out under the supervision of an appropriately experienced Engineer. This person shall be retained by the Permit Holder to ensure that the works are constructed in accordance with accepted engineering practice and are completed to a standard and condition to meet the requirements of this permit.

4. The Permit Holder shall employ best practicable option measures to ensure that occurrences of offensive or objectionable odours (from the treatment lagoon and/or the waste water effluent irrigation activities) beyond the property boundary are avoided.

Anaerobic Lagoon

5. The anaerobic lagoon shall be maintained and operated in a manner to ensure that the contents are fully retained in the lagoon at all times.

6. The anaerobic lagoon shall be provided with appropriate visual monitoring equipment that provides an immediate warning of any failure of the lining.

7. There shall be no offensive or objectionable odour beyond the property boundaries resulting from the operation of the anaerobic lagoon.

Effluent Irrigation

8. The effluent irrigation regime shall be managed according to an Effluent Irrigation Management Plan approved by **horizons.mw** with regard to the maintenance of buffer zones, riparian planting, stock management, storage pond capacity, daily and monthly monitoring of the irrigation system and water quality and soil testing.

9. The effluent irrigation system shall be constructed and managed so as to ensure a buffer zone of at least 20 metres is maintained between the disposal area (at the furthest throw of the sprinkler) and any streams, wetlands or low areas likely to flood in wet weather, drains and other natural surface waters.

10. No effluent spray-drift shall enter the Waimiha Stream or any of its tributaries.

11. Buffer zones adjacent to the permanent watercourses shall be fenced to exclude stock and planted with appropriate riparian vegetation. The type of riparian vegetation used shall be decided in consultation with the Team Leader Compliance, **horizons.mw**

12. There shall be no ponding as a result of irrigation and no surface run-off of effluent from the lagoons, pipelines, or disposal areas to any watercourse or wetland areas.

13. Sufficient effluent irrigation area, excluding buffer zones, shall be provided to ensure that the maximum hydraulic and nitrogen loading rates of 50 mm/day and 200 kg N /ha / year are not exceeded.

Emergencies

14. This permit does not authorise emergency discharges of effluent under any circumstances. The Permit Holder shall provide sufficient additional storage and/or have contingency management procedures in place to ensure unauthorised discharges of effluent do not occur due to wet weather surcharge flows, equipment malfunction or any other foreseeable cause.

15. The Permit Holder shall install and maintain an automatic shut-off valve that will stop the flow of effluent in the event of irrigation pipe rupture or significant leakage.

Monitoring

16. The Permit Holder shall keep an Environmental Log of the:

    a. Daily volumes of the effluent generated by the works and irrigated to land;
    b. Periods (times) and areas irrigated with effluent daily;
    c. Rainfall, wind direction and wind strength recorded on a daily basis;
    d. Any equipment malfunctions relating to the wastewater system (ie. pumps, lines, irrigators etc.) or pollution incidents and details of any repairs or actions taken to avoid environmental adverse effects.
    e. Any leaks identified at or around the pipe bridges (as identified under the inspections required under condition 22) and the action taken to remedy the leaks.

    This log shall be made available to **horizons.mw** staff on request.

17. The Permit Holder shall monitor:

    a. The water quality of the Waimiha Stream on a seasonal basis (once per month in the months January, May and September) at three sites; upstream, in the middle of and downstream of the irrigation area as shown on Plan C 100696 attached to and forming part of this Permit. The sites shall be established in consultation with **horizons.mw**'s Team Leader, Compliance. The samples shall be analysed by a suitably qualified laboratory for the following parameters:

    E. coli bacteria
    Suspended solids
    Nitrate and nitrite
    Total Kjeldahl nitrogen (TKN)
    Ammoniacal Nitrogen

b. The quality of the wastewater from the storage pond on a monthly basis. The sample shall be analysed by a suitably qualified laboratory for the following parameters:

Total Kjeldahl nitrogen (TKN)
Total chemical oxygen demand (COD)

In addition the following waste-water storage pond parameters shall be monitored once every six months

Total sodium
Calcium
Magnesium
Total Phosphorus
Total Potassium

The Applicant shall determine and record the effluent sodium adsorption ratio (SAR) based on these six monthly monitoring results.

c. Soil characteristics in the irrigation area. A soil-sampling programme is to be undertaken in November each year for the term of this permit. Three paddocks located in the effluent disposal areas and a control sample (a paddock not irrigated) shall be sampled. The paddocks sampled shall be varied in a rotation cycle each year to ensure that all paddocks receiving effluent are sampled over time. At least 20 cores shall be taken from each paddock at two depths, 0 - 10 and 10 – 20 cms. The samples shall be analysed for:

PH
Calcium
Phosphorus
Potassium
Sulphate-sulphur
Magnesium
Sodium
total nitrogen
base saturation

by a suitably qualified laboratory . The soil infiltration rate and the soil organic matter content shall also be measured in each of the paddocks sampled.

d. The results of the above analyses are to be supplied to **horizons.mw**'s Team Leader Compliance within two weeks of the completion of the analysis.

18. The Permit Holder shall prepare an annual report that includes the results of all monitoring of this resource consent and consents 100697, 100698 and 101365 and shall forward copies of the report to **horizons.mw**, Te Hape Marae and Miringi Te Kakara Marae by 30 June 2002 and by 30 June in every year thereafter for the term of this permit. The report shall include the following:

Condition 19 changed on 16 June 2004 as follows:
Within one month of receipt of the annual report required by Condition 18 of the Permit, the recipients of the annual report may request that the Consent Holder convene a public meeting to discuss the content and implications of the annual report.

i. summary of the monitoring results;
ii. discussion of the implication of these results,
iii. any incidences of non-compliance; and
iv. any actual or proposed changes to the operational waste water storage and disposal procedures or Irrigation Management Plan.

19. Within one month of the release of the report required by Condition 18 of the Permit, the Permit Holder shall hold at least one public community meeting to discuss the contents and implications of the report.

Management Plan

20. An Effluent Treatment and Irrigation Management Plan shall form a part of this permit. The existing Management Plan for the operation of the irrigation system shall be updated to reflect the operational regime authorised by this permit and re-submitted to **horizons.mw**'s Team Leader Compliance by ~~1 June~~ 20 July 2001 for approval.

Review

21. **horizons.mw** may, under Section 128 of the Act, initiate a review of conditions of this permit in April 2002, April 2006, and April 2011. The reviews may be necessary to assess the effectiveness of conditions of this permit, in avoiding, remedying or mitigating adverse effects on the environment.

The review of conditions shall allow for:

i. deletion or changes to conditions of this permit; and
ii. addition of new conditions as necessary; or
iii. the adoption of the best practicable options to avoid, remedy, or mitigate any adverse effects on the environment.

22. All pipe bridges conveying effluent shall be inspected monthly by the Permit Holder for leaks and /or deterioration and appropriate action taken.

23. The Permit Holder shall maintain a complaints register. The register shall record:

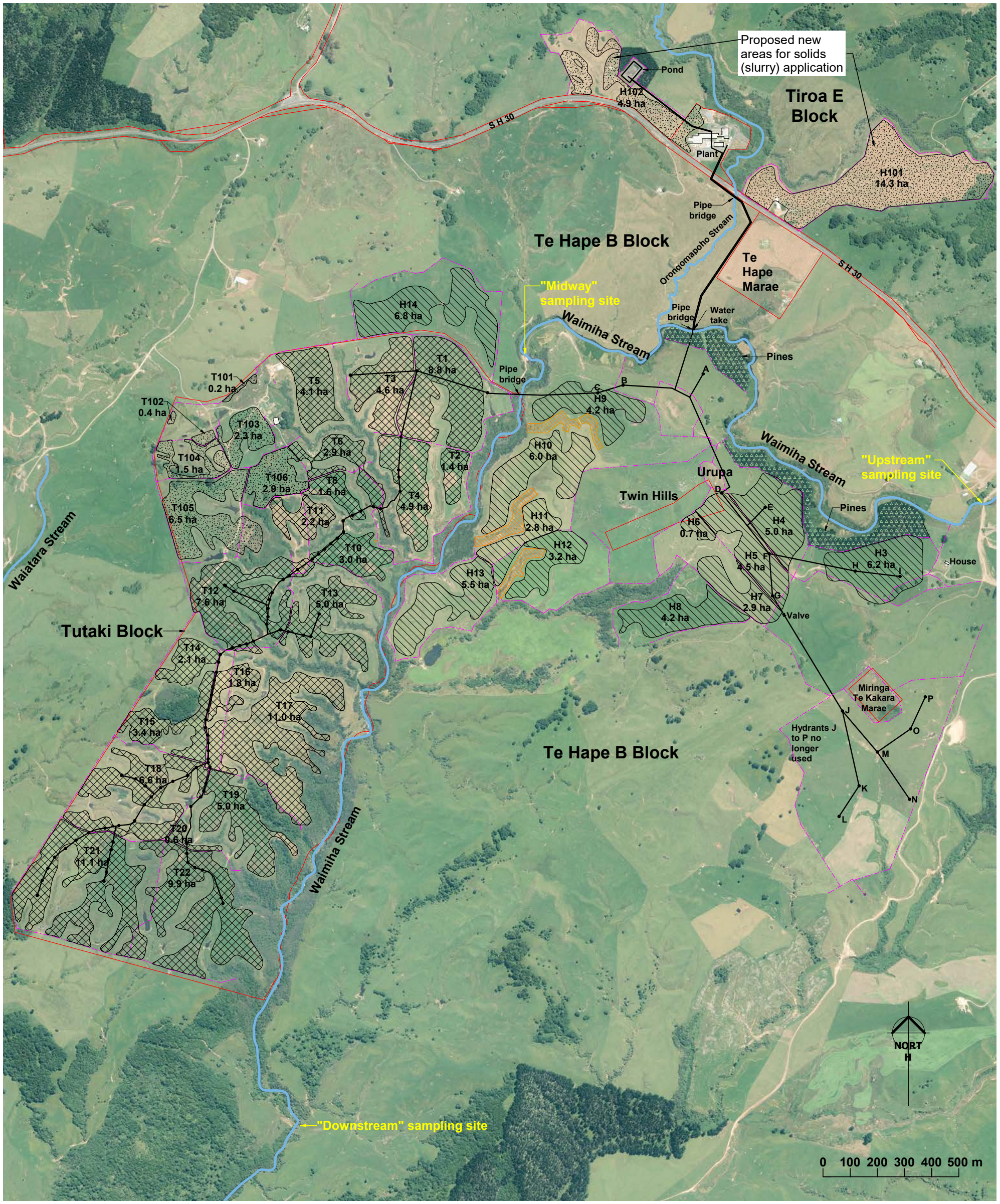
a. any public complaints it receives, and the time they were received;
b. weather conditions including wind direction at the time of complaint;
c. process operations and/or malfunctions at the time of complaint; and
d. remedial measures or other action taken as a result of the complaint.

The register shall be made available to **horizons.mw** staff on request.

24. Charges, set in accordance with Section 36(1)c of the Resource Management Act 1991, and Section 690 A of the Local Government Act 1974, shall be paid to **horizons.mw** for the carrying out of its functions in relation to the administration, monitoring and supervision of this resource consent and for the carrying out of its functions under Section 35 (duty to gather information, monitor, and keep records) of the Act.

[Note:Section 36(1)c of the Act provides that **horizons.mw** may from time to time fix charges payable by holders of resource consents. The procedure for setting administrative charges is governed by Section 36(2) of the Act and is currently carried out as part of the formulation of **horizons.mw**'s Annual Plan.]

Appendix 2. Irrigation Site Plan



Legend

- Major stream
- Property boundary
- Fenceline
- Irrigation main and hydrant
- Solids application area
- Irrigation Site - Te Hape Block
- Irrigation Site - Tutaki Block
- Wetland area to be fenced and planted

Crusader Meats Land Treatment System Site Plan

23 August 2016

ALBERT VAN OOSTROM & ASSOCIATES
WASTE MINIMISATION & TREATMENT SPECIALISTS

Appendix 2. Nutrient Budget Reports – Scenario 1

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Farm Summary

	Units	Current Farm	Average NZ Farm
Nutrient loss indices (whole farm)			
Loss to water	kg N/ha/yr	27	5-20
	kg P/ha/yr	1.2	
Includes loss from effluent pond of:	kg N/ha/yr	0	
	kg P/ha/yr	0	
Production efficiency indices			
Farm N surplus (pastoral)	kg N/ha/yr	82	30-80
N conversion efficiency (pastoral)	%	26	15-25
Effluent - area of pastoral farm			
Currently receiving effluent	ha	0	
Required to achieve application rate of 150 kg N/ha/yr		0	
Greenhouse gas emissions (CO_2 equivalents (CO2e))			
Total greenhouse gas emissions	CO2e/ha/yr	3332	

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Farm Nitrogen

	Units	Benchmark farm	Current farm
Inputs (farm average)			
Clover N	kg N/ha/yr		26
Fertiliser N	kg N/ha/yr		0
Other N added	kg N/ha/yr		84
Indices			
Average N loss to water	kg N/ha/yr	5-20	27
includes N lost as effluent	kg N/ha/yr		0
N_2O emissions	kg N/ha/yr		1.3
For pastoral area of farm:			
Farm N surplus	kg N/ha/yr	30-80	82
N conversion efficiency	%	15-25	26

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Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

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 irrigated	4559	47	4.1	134	175
Pastoral manure slurry appln	492	36	3.6	112	87
Pastoral buffer zones	896	14	N/A	45	0
Trees and scrub	42	3	N/A		
Other farm sources	52				
Whole farm	6041	27			
Less N removed in wetlands	0				
Farm output	6041	27			

* 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.

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Farm Phosphorus

	Units	Benchmark farm	Current farm
Inputs (farm average)			
P added as fertiliser	kg P/ha/yr		0
P imported as supplements	kg P/ha/yr		0
Other P added	kg P/ha/yr		17
Indices			
Average P loss to water	kg P/ha/yr		1.2
P lost from effluent pond	kg P/ha/yr		0
P surplus	kg P/ha/yr		13
For pastoral block, % of area with high or extreme:			
Soil P loss risk category	%		55
Fertiliser P loss risk category	%		0
Effluent P loss risk category	%		0

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Pastoral irrigated	159	1.6	High	n/a	n/a
Pastoral manure slurry appln	16	1.2	Medium	n/a	n/a
Pastoral buffer zones	89	1.4	Medium	n/a	n/a
Trees and scrub	1	0.1	n/a	n/a	n/a
Other farm sources	10				
Whole farm	275	1.2			

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Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Block Pasture

Block name	On-farm fresh pasture intake (kg DM/ha/yr)	Estimated utilisation (%)	Supplements removed (kg DM/ha/yr)	Pasture growth (kg DM/ha/yr)
Pastoral irrigated	5668	70	2336	10434
Pastoral manure slurry appln	6188	70	0	8839
Pastoral buffer zones	5409	70	0	7728
Trees and scrub	0	0	0	0

This report gives an estimated animal intake for each block based on animal production and supplements brought on to farm information supplied. Estimated annual pasture growth is shown for the animal utilisation value shown. Note: the model is not sensitive to changes in utilisation.

It is recommended that a consultant or software such as StockPol is used to estimate farm pasture production.

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Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added							
Fertiliser, lime & other	82	17	88	24	16	8	77
Rain/clover N fixation	28	0	1	3	2	4	10
Irrigation	0	0	0	0	0	0	0
Supplements imported	0	0	0	0	0	0	0
Nutrients removed							
As products	14	2	1	2	5	0	0
Exported effluent	0	0	0	0	0	0	0
As supplements	14	2	11	1	2	1	0
To atmospheric	18	0	0	0	0	0	0
To water	27	1.2	12	24	22	14	71
Change in internal pools							
Plant material	0	0	0	0	0	0	0
Organic pool	37	15	1	-1	0	0	0
Inorganic mineral	0	4	-3	0	-1	0	-3
Inorganic soil pool	0	-7	68	0	-11	-3	19

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Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Block Nutrient Budget - Pastoral irrigated

	N	P	K	S	Ca	Mg	Na	H+*
				(kg/ha/yr)				
Nutrients added								
Fertiliser, lime & organic	175	35	193	53	35	18	175	0.0
Rain/clover N fixation	16	0	2	3	2	4	12	0.3
Irrigation	0	0	0	0	0	0	0	0.0
Supplements fed on block	15	2	11	1	3	1	0	0.4
Nutrients removed								
As animal products	19	3	1	2	7	0	1	0.0
As supplements	52	6	39	3	9	2	2	-1.3
Net transfer by animals	2	0	1	0	0	0	0	0.0
To atmospheric	24	0	0	0	0	0	0	-0.2
To water	47	1.6	17	44	38	19	94	-2.4
Change in internal pools								
Organic pool	63	25	0	7	0	0	0	-2.2
Inorganic mineral	0	7	-1	0	-1	0	-4	0.0
Inorganic soil pool	0	-6	148	0	-13	1	95	6.8

* Acidity - used in calculation of maintenance lime requirements. A gain in acidity indicates that soil pH will decrease.

General Comments

This page gives some general comments about the outputs. Other block specific information may be available as following reports.

The interpretation of environmental impacts is dependent on regional and catchment based criteria, of which many are still being developed as part of regional and central government policy. The interpretation may also be dependent on other organisations within the supply chain. Therefore it is important that information is sought from these bodies before interpreting the nutrient budget.

Soil P loss status is high. Consider reducing Olsen P levels.

Fertiliser P loss is greater than 10% of total P loss and 1.5 kg P/ha/yr - this is outside the range of data available for New Zealand and P loss data should be used with caution. Potential P loss from fertiliser is high. Check fertiliser rates are not too high. If P is applied in high risk months consider alternative months of application or changing the form of P.

Estimated change in soil test values for samples taken to 7.5cm:

Decrease in Olsen P test of 2 units

Increase in QT K test of 2 units

No change in QT Mg test

High N removal in supplement sold. Model assumes this is replaced from increased clover growth and N fixation. If clover growth is not strong, review management and adequacy of N inputs.

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Block Nutrient Budget - Pastoral irrigated

Soil is slowly acidifying and would be neutralised by a maintenance lime application of 340 kg/ha/yr pure lime. Review soil pH and lime requirement.

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Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Block Nutrient Budget - Pastoral manure slurr

	N	P	K	S	Ca	Mg	Na	H+*
				(kg/ha/yr)				
Nutrients added								
Fertiliser, lime & organic	87	22	54	14	14	3	5	0.0
Rain/clover N fixation	33	0	2	3	2	4	12	0.6
Irrigation	0	0	0	0	0	0	0	0.0
Supplements fed on block	15	2	11	1	3	1	0	0.4
Nutrients removed								
As animal products	20	3	1	3	7	0	1	0.0
As supplements	0	0	0	0	0	0	0	0.0
Net transfer by animals	2	0	2	0	0	0	0	0.0
To atmospheric	26	0	0	0	0	0	0	0.0
To water	36	1.2	12	14	29	16	78	-1.0
Change in internal pools								
Organic pool	50	16	0	1	0	0	0	-0.1
Inorganic mineral	0	4	-2	0	-1	0	-4	0.0
Inorganic soil pool	0	-1	55	0	-17	-8	-57	2.1

* Acidity - used in calculation of maintenance lime requirements. A gain in acidity indicates that soil pH will decrease.

General Comments

This page gives some general comments about the outputs. Other block specific information may be available as following reports.

The interpretation of environmental impacts is dependent on regional and catchment based criteria, of which many are still being developed as part of regional and central government policy. The interpretation may also be dependent on other organisations within the supply chain. Therefore it is important that information is sought from these bodies before interpreting the nutrient budget.

Soil P loss status is high. Consider reducing Olsen P levels.

Fertiliser P loss is greater than 10% of total P loss and 1.5 kg P/ha/yr - this is outside the range of data available for New Zealand and P loss data should be used with caution. Potential P loss from fertiliser is high. Check fertiliser rates are not too high. If P is applied in high risk months consider alternative months of application or changing the form of P.

The change in inorganic soil pool indicates that additional fertiliser nutrients may be required to maintain production for Na

Estimated change in soil test values for samples taken to 7.5cm:

Decrease in Olsen P test of 1 units

Increase in QT K test of 1 units

Decrease in QT Mg test of 1 units

Soil Mg status is slowly declining. Mg containing fertiliser will eventually be needed to maintain current production.

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Block Nutrient Budget - Pastoral manure slurr

Soil Na status is slowly declining. Check pasture Na status, especially on pumice soil, to ascertain need for Na supplementation.

Soil is slowly acidifying and would be neutralised by a maintenance lime application of 110 kg/ha/yr pure lime. Review soil pH and lime requirement.

Version 6.2.2, on 2016-08-30 05:32:04

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Block Nutrient Budget - Pastoral buffer zones

	N	P	K	S	Ca	Mg	Na	H+*
				(kg/ha/yr)				
Nutrients added								
Fertiliser, lime & organic	0	0	0	0	0	0	0	0.0
Rain/clover N fixation	63	0	2	3	2	4	12	0.3
Irrigation	0	0	0	0	0	0	0	0.0
Supplements fed on block	0	0	0	0	0	0	0	0.0
Nutrients removed								
As animal products	16	3	1	2	6	0	1	0.0
As supplements	0	0	0	0	0	0	0	0.0
Net transfer by animals	2	0	1	0	0	0	0	0.0
To atmospheric	18	0	0	0	0	0	0	0.0
To water	14	1.4	12	14	12	14	81	-0.6
Change in internal pools								
Organic pool	13	11	0	-13	0	0	0	-0.1
Inorganic mineral	0	2	-6	0	-1	0	-4	0.0
Inorganic soil pool	0	-17	-6	0	-15	-9	-66	1.0

* Acidity - used in calculation of maintenance lime requirements. A gain in acidity indicates that soil pH will decrease.

General Comments

This page gives some general comments about the outputs. Other block specific information may be available as following reports.

The interpretation of environmental impacts is dependent on regional and catchment based criteria, of which many are still being developed as part of regional and central government policy. The interpretation may also be dependent on other organisations within the supply chain. Therefore it is important that information is sought from these bodies before interpreting the nutrient budget.

Soil P loss status is high. Consider reducing Olsen P levels.

Fertiliser P loss is greater than 10% of total P loss and 1.5 kg P/ha/yr - this is outside the range of data available for New Zealand and P loss data should be used with caution. Potential P loss from fertiliser is high. Check fertiliser rates are not too high. If P is applied in high risk months consider alternative months of application or changing the form of P.

The change in inorganic soil pool indicates that additional fertiliser nutrients may be required to maintain production for Na

Estimated change in soil test values for samples taken to 7.5cm:

Decrease in Olsen P test of 4 units

Decrease in QT K test of 1 units

Decrease in QT Mg test of 1 units

Soil Mg status is slowly declining. Mg containing fertiliser will eventually be needed to maintain current production.

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Block Nutrient Budget - Pastoral buffer zones

Soil Na status is slowly declining. Check pasture Na status, especially on pumice soil, to ascertain need for Na supplementation.

Soil is slowly acidifying and would be neutralised by a maintenance lime application of 50 kg/ha/yr pure lime. Review soil pH and lime requirement.

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Block Nutrient Budget - Trees and scrub

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added							
Rain/clover N fixation	3	0	2	3	2	4	12
Nutrients removed							
To water	3	0.1	2	3	2	4	12
Change in internal pools							
Inorganic mineral	0	0	0	0	0	0	0

* Acidity - used in calculation of maintenance lime requirements. A gain in acidity indicates that soil pH will decrease.

General Comments

There are no comments for this report.

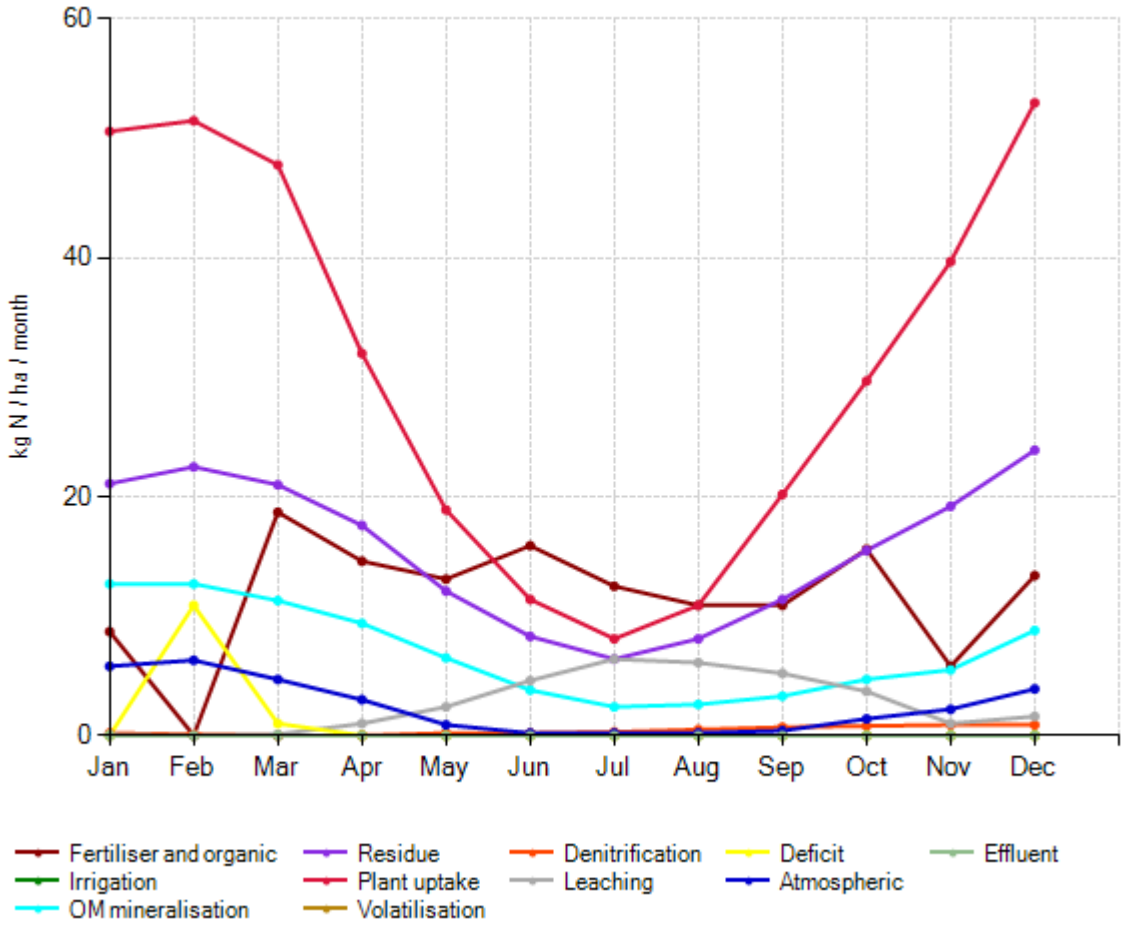
Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Change in N Pools for block - Pastoral irrigat



Version 6.2.2, on 2016-08-30 05:31:26

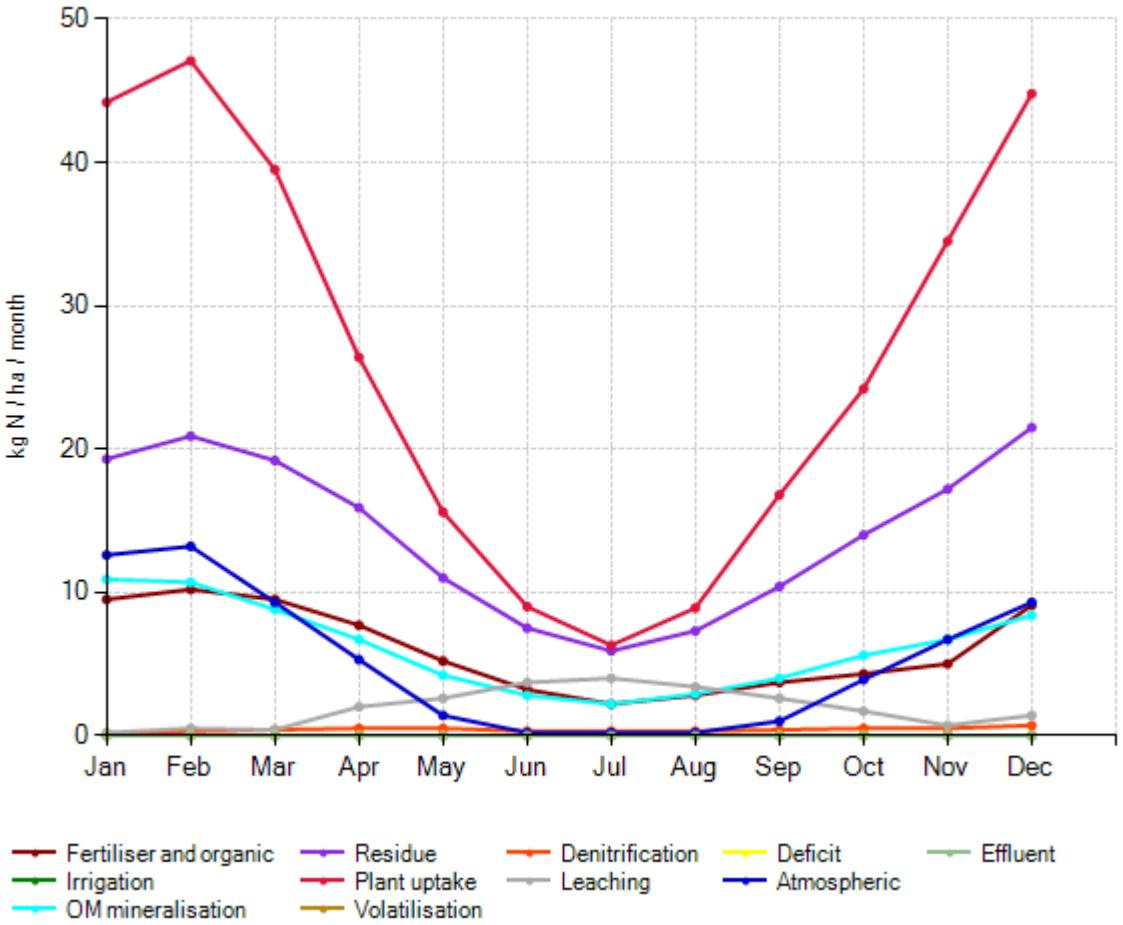
Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Change in N Pools for block - Pastoral manu



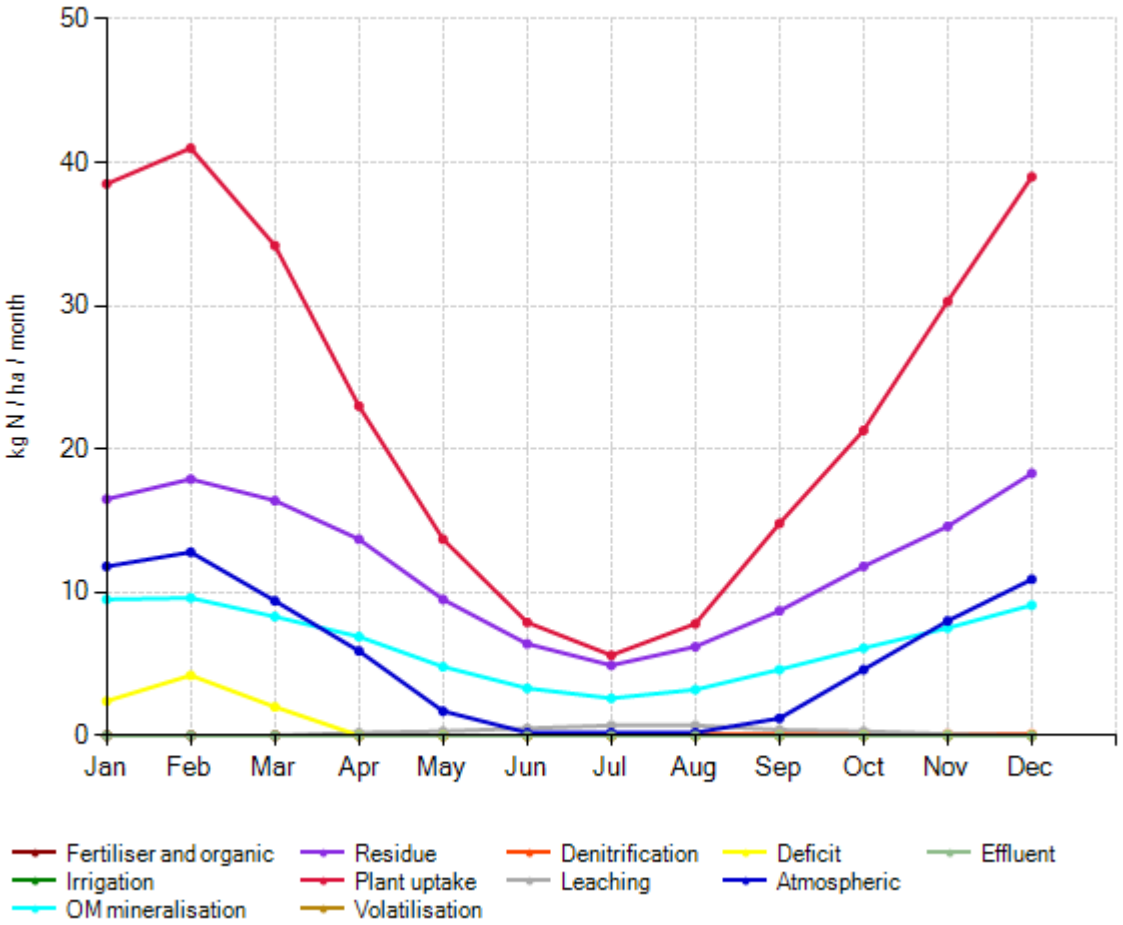
Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Change in N Pools for block - Pastoral buffer



Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Other values for farm - Tutaki Block - Scenari

Percent male beef animals	86
Total liveweight brought (kg/ha grazed)	693
Total liveweight reared (kg/ha grazed)	382
Total liveweight sold (kg/ha grazed)	1103
$ on fertiliser per ha	$0.00
GHG: Allocation to wool - breeding mob	0.05
GHG: Allocation to wool - trading mob	0.02
Sheep stock rate (RSU)	1224
Beef / dairy grazing stock rate (RSU)	656

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Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Other values for block - Pastoral irrigated

Relative yield (from soil tests & fertiliser)	68
Pasture utilisation (%)	70
Annual average temperature (C)	10.9
Annual rainfall (mm/yr)	1646
Annual irrigation supplied (mm/yr)	0
Added to pasture (mm/yr)	0
Annual AET (mm/yr)	627
Annual drainage (mm/yr)	1123
Annual runoff (mm/yr)	70
Field capacity (mm to 60 cm)	222
Wilting point (mm to 60 cm)	93
Saturation (mm to 60 cm)	408
Profile available water (PAW) (mm to 60 cm)	129
$ on fertiliser per ha	$0.00
$ on fertiliser equivalent of organic per ha	$837.27
Urine N risk index	21

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Other values for block - Pastoral manure slur

Relative yield (from soil tests & fertiliser)	57
Pasture utilisation (%)	70
Annual average temperature (C)	10.9
Annual rainfall (mm/yr)	1646
Annual irrigation supplied (mm/yr)	0
Added to pasture (mm/yr)	0
Annual AET (mm/yr)	631
Annual drainage (mm/yr)	965
Annual runoff (mm/yr)	49
Field capacity (mm to 60 cm)	231
Wilting point (mm to 60 cm)	96
Saturation (mm to 60 cm)	402
Profile available water (PAW) (mm to 60 cm)	135
$ on fertiliser per ha	$0.00
$ on fertiliser equivalent of organic per ha	$285.28
Urine N risk index	15.7

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Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Other values for block - Pastoral buffer zones

Relative yield (from soil tests & fertiliser)	50
Pasture utilisation (%)	70
Annual average temperature (C)	10.9
Annual rainfall (mm/yr)	1646
Annual irrigation supplied (mm/yr)	0
Added to pasture (mm/yr)	0
Annual AET (mm/yr)	631
Annual drainage (mm/yr)	908
Annual runoff (mm/yr)	107
Field capacity (mm to 60 cm)	222
Wilting point (mm to 60 cm)	93
Saturation (mm to 60 cm)	408
Profile available water (PAW) (mm to 60 cm)	129
$ on fertiliser per ha	$0.00
Urine N risk index	14.5

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Parameters

Farm details

Type	Farm type	Full range
Assessment	Assessment year	Not entered
Region	Region	Waikato/Coromandel

Farm blocks

Pastoral irrigated	Pastoral	97.6
Pastoral manure slurry appln	Pastoral	13.8
Pastoral buffer zones	Pastoral	65
Trees and scrub	Trees and Scrub	14
Total farm area declared in blocks	ha	190.4
Total farm area	ha	222.5
Non-productive area	ha	32.1

Farm animals

Stock numbers

Stock reconciliation - Sheep

Stock production

Lambing percentage	%	120
Percent replacements	%	20
Mean lambing date		Not entered
Mean weaning date		Not entered
Weaning weight	kg	Not entered
Wool production	kg/yr	Not entered

Stock numbers

Mob name	Class	Breed	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Lambs	Lambs	Romney	388	364	355	0	0	0	0	0	0	0	0	0
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	10	On-farm	Sold to store	MixedSex						
Lambs	Lambs	Romney	0	0	170	161	161	161	161	155	114	0	0	0
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	1	On-farm	Sold to store	MixedSex						
Lambs	Lambs	Romney	0	0	0	0	0	0	95	95	95	0	0	0
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	4	Brought	Sold to store	MixedSex						
Lambs	Lambs	Romney	0	0	0	0	0	0	0	0	0	848	846	652
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	7	Brought	Sold to store	MixedSex						
Lambs	Lambs	Romney	0	0	0	0	0	0	0	0	0	0	502	492
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	8	Brought	Sold to store	MixedSex						
BreedingRams	BreedingRams	Romney	2	2	1	1	1	1	1	1	1	5	5	5
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	0			Male						
BreedingEwesMixedAge	BreedingEwesMixedAge	Romney	154	151	149	144	82	999	1948	3937	2032	634	428	420
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	0			Female						

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Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Parameters

Stock reconciliation - Beef / dairy grazing

Stock production

Calving percentage	%	Not entered
Percent replacements	%	Not entered
Mean calving date		Not entered
Mean weaning date		Not entered
Weaning weight	kg	Not entered

Stock numbers

Mob name	Class	Breed	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
HeifersAndCows	HeifersAndCows	Angus	61	61	61	61	11	11	11	11	11	11	11	0
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	9	On-farm	Sold to store	Female						
Steers	Steers	Angus	3	3	3	3	125	125	140	140	140	140	140	140
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	9	On-farm	Remain on-farm	Castrated						
Steers	Steers	Angus	41	41	41	41	2	2	2	2	2	2	2	0
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	21	On-farm	Sold to store	Castrated						

Animal excreta distribution

Relative productivity assessment method	Relative yield (from soil, fertiliser inputs)

Relative productivity calculated for each Pastoral block

Pastoral irrigated	0.676100454512161
Pastoral manure slurry appln	0.572782331300863
Pastoral buffer zones	0.500737090897317

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

Animal health supplements

Animal - Sheep

No animal supplementation has been entered

Animal - Beef / dairy grazing

No animal supplementation has been entered

Left over feeding

No left over feeding specified
No supplements from storage added to this farm
No supplements imported onto this farm

Block Information

Block - Pastoral irrigated

Block name	Pastoral irrigated
Block type	Pastoral

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Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Parameters

Block type		Pastoral
Area	ha	97.6
Relative productivity		0
Pasture block type		No
Topography		Rolling
Distance from coast	km	71
Cultivated in last 5 years		True
Climate		
Annual average rainfall	mm/yr	1646
Mean annual temperature		10.9
Seasonal variation in rainfall		1450-2900 mm, Moderate
Annual potential evapotranspiration		651-800 mm/yr
Seasonal variation in PET		Moderate
Soil description		
Soil order (default)		Podzol
Soil group (default)		Podzol
SMaps	Sibling	Maro_11a.1
Date downloaded		2016 August 19 01:32
Wilting point	0 - 30cm	15
	30 - 60cm	16
	> 60	19
Field capacity	0 - 30cm	35
	30 - 60cm	39
	> 60	45
Saturation	0 - 30cm	70
	30 - 60cm	66
	> 60	66
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0
Depth to impeded layer	cm	0
Soil texture group		Light
Non-standard layer		
Depth to non-standard layer	cm	0
Top soil horizon chemical and physical parameters		
ASC/PR		42
Sand	%	65
Natural drainage class		Well
Bulk density	kg/m^3	1090
Clay	%	12
Sub soil clay	%	11
Soil profile		
Compacted top soil		False
Stony top soil		False
Depth to impeded drainage layer		0
Maximum rooting depth	m	0
Top soil texture		Unknown

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Client reference:

Farm name: Tutaki Block - Scenario 1

Parameters

Soil drainage
- Profile drainage class: Use default
- Hydrophobic condition: Rain always soaks in

Drainage method
- Method: None

Soil settings
- K leaching potential not set
- N immobilisation status: Standard

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
18	6	5	10	7

- Organic S: 7
- 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

Supplements removed

Supplement information
- Conservation type: Silage
- Name
- Pasture type
- Wrapping: Wrapped in plastic

Supplement amount
- Number of bales: T 300
- Packaging: Round bales

Bale size
- Dimensions: H: 120 R: 120
- Fed on blocks: Pastoral irrigated, Pastoral manure slurry appln,
- No feeding destinations found

Supplement information
- Conservation type: Silage
- Name
- Pasture type
- Wrapping: Wrapped in plastic

Supplement amount
- Number of bales: T 500
- Packaging: Round bales

Bale size

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Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Parameters

Bale size
- Dimensions: H: 120 R: 120
- Supplement is exported from the farm

Fertiliser application

Other nutrient inputs - July
- Description: Anaerobic pond effluent
- Source: Custom effluent
- Rate: 156022

Other nutrient inputs - August
- Description: Anaerobic pond effluent
- Source: Custom effluent
- Rate: 136469

Other nutrient inputs - September
- Description: Anaerobic pond effluent
- Source: Custom effluent
- Rate: 136228

Other nutrient inputs - October
- Description: Anaerobic pond effluent
- Source: Custom effluent
- Rate: 195314

Other nutrient inputs - November
- Description: Anaerobic pond effluent
- Source: Custom effluent
- Rate: 72231

Other nutrient inputs - December
- Description: Anaerobic pond effluent
- Source: Custom effluent
- Rate: 167494

Other nutrient inputs - January
- Description: Anaerobic pond effluent
- Source: Custom effluent
- Rate: 108801

Other nutrient inputs - March
- Description: Anaerobic pond effluent
- Source: Custom effluent

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Client reference:

Farm name: Tutaki Block - Scenario 1

Parameters

Source			Custom effluent
Rate			233769
Other nutrient inputs - April			
Description			Anaerobic pond effluent
Source			Custom effluent
Rate			182430
Other nutrient inputs - May			
Description			Anaerobic pond effluent
Source			Custom effluent
Rate			163478
Other nutrient inputs - June			
Description			Anaerobic pond effluent
Source			Custom effluent
Rate			198643
Previous lime applications			
Lime material			McDonalds lime
Rate	kg/ha		1000
Dissolves within the year			False
Years since lime applied			2

Irrigation

No irrigation entered

Irrigation concentrations

N	P	K	S	Ca	Mg	Na	H
0	0	0	0	0	0	0	0

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		
Sheep	%	0
Block intensity		
Merino		False

Animal grazing

Sheep graze block all year round

Animals grazing		
Beef / dairy grazing	%	0

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Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Parameters

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 manure slurry appln

Block name		Pastoral manure slurry appln
Block type		Pastoral
Area	ha	13.8
Relative productivity		0
Pasture block type		No
Topography		Rolling
Distance from coast	km	71
Cultivated in last 5 years		False

Climate

Annual average rainfall	mm/yr	1646
Mean annual temperature		10.9
Seasonal variation in rainfall		1450-2900 mm, Moderate
Annual potential evapotranspiration		651-800 mm/yr
Seasonal variation in PET		Low

Soil description

Soil order (default)		Podzol
Soil group (default)		Podzol
SMaps	Sibling	Ngong_10a.1
Date downloaded		2016 August 24 04:27
Wilting point	0 - 30cm	21
	30 - 60cm	11
	> 60	17
Field capacity	0 - 30cm	41
	30 - 60cm	36
	> 60	39
Saturation	0 - 30cm	70
	30 - 60cm	64
	> 60	68
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0
Depth to impeded layer	cm	0
Soil texture group		Light
Non-standard layer		
Depth to non-standard layer	cm	0

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Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Parameters

Top soil horizon chemical and physical parameters

ASC/PR		42
Sand	%	55
Natural drainage class		Well
Bulk density	kg/m^3	1090
Clay	%	12
Sub soil clay	%	11

Soil profile

Compacted top soil		False
Stony top soil		False
Depth to impeded drainage layer		0
Maximum rooting depth	m	0
Top soil texture		Unknown

Soil drainage

Profile drainage class	Use default
Hydrophobic condition	Use default

Drainage method

Method	None

Soil settings

K leaching potential not set	
N immobilisation status	Standard

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
11	4	5	8	4

Organic S	7
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

Supplements removed

No supplements removed from this block

Fertiliser application

Other nutrient inputs - July

Description		Manure slurry
Rate		9
DM content	%	8
Percentage N in organic form		15

Other nutrient inputs - August

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Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Parameters

Other nutrient inputs - August		
Description		Manure slurry
Rate		9
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - September		
Description		Manure slurry
Rate		9
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - October		
Description		Manure slurry
Rate		9
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - November		
Description		Manure slurry
Rate		19
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - December		
Description		Manure slurry
Rate		75
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - January		
Description		Manure slurry
Rate		75
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - February		
Description		Manure slurry
Rate		75
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - March		
Description		Manure slurry

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Client reference:

Farm name: Tutaki Block - Scenario 1

Parameters

Description		Manure slurry
Rate		75
DM content	%	8
Percentage N in organic form		15

Other nutrient inputs - April

Description		Manure slurry
Rate		56
DM content	%	8
Percentage N in organic form		15

Other nutrient inputs - May

Description		Manure slurry
Rate		38
DM content	%	8
Percentage N in organic form		15

Other nutrient inputs - June

Description		Manure slurry
Rate		19
DM content	%	8
Percentage N in organic form		15

Previous lime applications

Lime material		McDonalds lime
Rate	kg/ha	1000
Dissolves within the year		False
Years since lime applied		2

Irrigation

No irrigation entered

Irrigation concentrations

N	P	K	S	Ca	Mg	Na	H
0	0	0	0	0	0	0	0

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

Sheep	%	0

Block intensity

Merino	False

Animal grazing

Sheep graze block all year round

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Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Parameters

Sheep graze block all year round

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 buffer zones

Block name		Pastoral buffer zones
Block type		Pastoral
Area	ha	65
Relative productivity		0
Pasture block type		No
Topography		Easy hill
Distance from coast	km	71
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1646
Mean annual temperature		10.9
Seasonal variation in rainfall		1450-2900 mm, Moderate
Annual potential evapotranspiration		651-800 mm/yr
Seasonal variation in PET		Low
Soil description		
Soil order (default)		Podzol
Soil group (default)		Podzol
SMaps	Sibling	Maro_11a.1
Date downloaded		2016 August 19 01:32
Wilting point	0 - 30cm	15
	30 - 60cm	16
	> 60	19
Field capacity	0 - 30cm	35
	30 - 60cm	39
	> 60	45
Saturation	0 - 30cm	70
	30 - 60cm	66
	> 60	66
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0
Depth to impeded layer	cm	0

Parameters

Depth to impeded layer	cm	0
Soil texture group		Light
Non-standard layer		
Depth to non-standard layer	cm	0

Top soil horizon chemical and physical parameters

ASC/PR		42
Sand	%	65
Natural drainage class		Well
Bulk density	kg/m³	1090
Clay	%	12
Sub soil clay	%	11

Soil profile

Compacted top soil		False
Stony top soil		False
Depth to impeded drainage layer		0
Maximum rooting depth	m	0
Top soil texture		Unknown

Soil drainage

Profile drainage class	Use default
Hydrophobic condition	Use default

Drainage method

Method	None

Soil settings

K leaching potential not set

N immobilisation status	Standard

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
7	4	3	7	4

Organic S	7
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

Supplements removed

No supplements removed from this block

Fertiliser application

No fertiliser application applied on block

Irrigation

No irrigation entered

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 1

Parameters

No irrigation entered

Irrigation concentrations

N	P	K	S	Ca	Mg	Na	H
0	0	0	0	0	0	0	0

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

Sheep	%	0

Block intensity

Merino	False

Animal grazing

Sheep graze block all year round

Animals grazing

Beef / dairy grazing	%	0

Block intensity

Finishing beef	False

Water connectivity

Direct access to streams	True

Animal grazing

Beef / dairy grazing graze block all year round

Effluent application

Receives no liquid or solid effluents

Block - Trees and scrub

Block name		Trees and scrub
Block type		Trees and Scrub
Area	ha	14
Rainfall	mm/yr	1646
Distance from coast	km	71
Bush type		Native

Report settings

Greenhouse gas emission report units: CO2 equivalents (kg/ha)
Target N application rate as effluent: kg N/ha/yr

Fertiliser costs $/kg nutrient

N	P	K	S	Ca	Mg	Na
1.4800000190 7349	2.7599999904 6326	1.4500000476 8372	0.6299999952 31628	0.1000000014 90116	1.4600000381 4697	0.8000000119 20929

Appendix 3. Nutrient Budget Reports – Scenario 2

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Farm Summary

	Units	Current Farm	Average NZ Farm
Nutrient loss indices (whole farm)			
Loss to water	kg N/ha/yr	29	5-20
	kg P/ha/yr	1.2	
Includes loss from effluent pond of:	kg N/ha/yr	0	
	kg P/ha/yr	0	
Production efficiency indices			
Farm N surplus (pastoral)	kg N/ha/yr	97	30-80
N conversion efficiency (pastoral)	%	23	15-25
Effluent - area of pastoral farm			
Currently receiving effluent	ha	0	
Required to achieve application rate of 150 kg N/ha/yr		0	
Greenhouse gas emissions (CO_2 equivalents (CO2e))			
Total greenhouse gas emissions	CO2e/ha/yr	3423	

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Farm Nitrogen

	Units	Benchmark farm	Current farm
Inputs (farm average)			
Clover N	kg N/ha/yr		24
Fertiliser N	kg N/ha/yr		0
Other N added	kg N/ha/yr		102
Indices			
Average N loss to water	kg N/ha/yr	5-20	29
includes N lost as effluent	kg N/ha/yr		0
N_2O emissions	kg N/ha/yr		1.3
For pastoral area of farm:			
Farm N surplus	kg N/ha/yr	30-80	97
N conversion efficiency	%	15-25	23

Version 6.2.2, on 2016-08-30 06:42:20

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

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 irrigated	4813	49	4.2	155	200
Pastoral manure slurry appln	404	61	6.3	211	200
Pastoral buffer zones	897	14	N/A	46	0
Trees and scrub	42	3	N/A		
Pastoral pond slurry appln	316	44	4.5	211	200
Other farm sources	52				
Whole farm	6524	29			
Less N removed in wetlands	0				
Farm output	6524	29			

* 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.

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Farm Phosphorus

	Units	Benchmark farm	Current farm
Inputs (farm average)			
P added as fertiliser	kg P/ha/yr		0
P imported as supplements	kg P/ha/yr		0
Other P added	kg P/ha/yr		20
Indices			
Average P loss to water	kg P/ha/yr		1.2
P lost from effluent pond	kg P/ha/yr		0
P surplus	kg P/ha/yr		16
For pastoral block, % of area with high or extreme:			
Soil P loss risk category	%		55
Fertiliser P loss risk category	%		0
Effluent P loss risk category	%		0

Version 6.2.2, on 2016-08-30 06:42:34

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Pastoral irrigated	159	1.6	High	n/a	n/a
Pastoral manure slurry appln	8	1.2	Medium	n/a	n/a
Pastoral buffer zones	89	1.4	Medium	n/a	n/a
Trees and scrub	1	0.1	n/a	n/a	n/a
Pastoral pond slurry appln	8	1.2	Medium	n/a	n/a
Other farm sources	10				
Whole farm	275	1.2			

Version 6.2.2, on 2016-08-30 06:44:08

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Block Pasture

Block name	On-farm fresh pasture intake (kg DM/ha/yr)	Estimated utilisation (%)	Supplements removed (kg DM/ha/yr)	Pasture growth (kg DM/ha/yr)
Pastoral irrigated	5668	70	2336	10434
Pastoral manure slurry appln	6188	70	0	8839
Pastoral buffer zones	5409	70	0	7728
Trees and scrub	0	0	0	0
Pastoral pond slurry appln	6188	70	0	8839

This report gives an estimated animal intake for each block based on animal production and supplements brought on to farm information supplied. Estimated annual pasture growth is shown for the animal utilisation value shown. Note: the model is not sensitive to changes in utilisation.

It is recommended that a consultant or software such as StockPol is used to estimate farm pasture production.

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Farm Nutrient Budget - Whole farm

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added							
Fertiliser, lime & other	100	20	101	29	20	9	89
Rain/clover N fixation	25	0	1	3	2	4	10
Irrigation	0	0	0	0	0	0	0
Supplements imported	0	0	0	0	0	0	0
Nutrients removed							
As products	14	2	1	2	5	0	0
Exported effluent	0	0	0	0	0	0	0
As supplements	14	2	11	1	2	1	0
To atmospheric	18	0	0	0	0	0	0
To water	29	1.2	12	29	24	14	71
Change in internal pools							
Plant material	0	0	0	0	0	0	0
Organic pool	49	15	1	0	0	0	0
Inorganic mineral	0	4	-3	0	-1	0	-3
Inorganic soil pool	0	-5	81	0	-8	-2	30

Version 6.2.2, on 2016-08-30 06:46:24

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Block Nutrient Budget - Pastoral irrigated

	N	P	K	S	Ca	Mg	Na	H+*
				(kg/ha/yr)				
Nutrients added								
Fertiliser, lime & organic	200	40	220	60	40	20	200	0.0
Rain/clover N fixation	12	0	2	3	2	4	12	0.2
Irrigation	0	0	0	0	0	0	0	0.0
Supplements fed on block	15	2	11	1	3	1	0	0.4
Nutrients removed								
As animal products	19	3	1	2	7	0	1	0.0
As supplements	52	6	39	3	9	2	2	-1.3
Net transfer by animals	2	0	1	0	0	0	0	0.0
To atmospheric	25	0	0	0	0	0	0	-0.3
To water	49	1.6	17	51	40	20	96	-2.6
Change in internal pools								
Organic pool	80	25	0	8	0	0	0	-2.7
Inorganic mineral	0	7	-1	0	-1	0	-4	0.0
Inorganic soil pool	0	-1	176	0	-10	3	118	7.4

* Acidity - used in calculation of maintenance lime requirements. A gain in acidity indicates that soil pH will decrease.

General Comments

This page gives some general comments about the outputs. Other block specific information may be available as following reports.

The interpretation of environmental impacts is dependent on regional and catchment based criteria, of which many are still being developed as part of regional and central government policy. The interpretation may also be dependent on other organisations within the supply chain. Therefore it is important that information is sought from these bodies before interpreting the nutrient budget.

Soil P loss status is high. Consider reducing Olsen P levels.

Fertiliser P loss is greater than 10% of total P loss and 1.5 kg P/ha/yr - this is outside the range of data available for New Zealand and P loss data should be used with caution. Potential P loss from fertiliser is high. Check fertiliser rates are not too high. If P is applied in high risk months consider alternative months of application or changing the form of P.

Estimated change in soil test values for samples taken to 7.5cm:

Decrease in Olsen P test of 1 units

Increase in QT K test of 3 units

No change in QT Mg test

High N removal in supplement sold. Model assumes this is replaced from increased clover growth and N fixation. If clover growth is not strong, review management and adequacy of N inputs.

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Block Nutrient Budget - Pastoral irrigated

Soil is slowly acidifying and would be neutralised by a maintenance lime application of 370 kg/ha/yr pure lime. Review soil pH and lime requirement.

Version 6.2.2, on 2016-08-30 06:49:03

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Block Nutrient Budget - Pastoral manure slurr

	N	P	K	S	Ca	Mg	Na	H+*
				(kg/ha/yr)				
Nutrients added								
Fertiliser, lime & organic	200	50	125	31	31	6	13	0.0
Rain/clover N fixation	18	0	2	3	2	4	12	0.4
Irrigation	0	0	0	0	0	0	0	0.0
Supplements fed on block	15	2	11	1	3	1	0	0.4
Nutrients removed								
As animal products	20	3	1	3	7	0	1	0.0
As supplements	0	0	0	0	0	0	0	0.0
Net transfer by animals	2	0	2	0	0	0	0	0.0
To atmospheric	32	0	0	0	0	0	0	-0.1
To water	61	1.2	12	32	49	16	78	-1.4
Change in internal pools								
Organic pool	117	16	0	1	0	0	0	-0.2
Inorganic mineral	0	4	-2	0	-1	0	-4	0.0
Inorganic soil pool	0	27	126	0	-19	-5	-50	2.5

* Acidity - used in calculation of maintenance lime requirements. A gain in acidity indicates that soil pH will decrease.

General Comments

This page gives some general comments about the outputs. Other block specific information may be available as following reports.

The interpretation of environmental impacts is dependent on regional and catchment based criteria, of which many are still being developed as part of regional and central government policy. The interpretation may also be dependent on other organisations within the supply chain. Therefore it is important that information is sought from these bodies before interpreting the nutrient budget.

Soil P loss status is high. Consider reducing Olsen P levels.

Fertiliser P loss is greater than 10% of total P loss and 1.5 kg P/ha/yr - this is outside the range of data available for New Zealand and P loss data should be used with caution. Potential P loss from fertiliser is high. Check fertiliser rates are not too high. If P is applied in high risk months consider alternative months of application or changing the form of P.

The change in inorganic soil pool indicates that additional fertiliser nutrients may be required to maintain production for Na

Estimated change in soil test values for samples taken to 7.5cm:

Increase in Olsen P test of 5 units

Increase in QT K test of 2 units

Decrease in QT Mg test of 1 units

Soil Na status is slowly declining. Check pasture Na status, especially on pumice soil, to ascertain need for Na supplementation.

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Block Nutrient Budget - Pastoral manure slurr

Soil is slowly acidifying and would be neutralised by a maintenance lime application of 120 kg/ha/yr pure lime. Review soil pH and lime requirement.

Version 6.2.2, on 2016-08-30 06:53:08

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Block Nutrient Budget - Pastoral pond slurry a

	N	P	K	S	Ca	Mg	Na	H+*
				(kg/ha/yr)				
Nutrients added								
Fertiliser, lime & organic	200	17	33	58	58	8	17	0.0
Rain/clover N fixation	19	0	2	3	2	4	12	0.3
Irrigation	0	0	0	0	0	0	0	0.0
Supplements fed on block	15	2	11	1	3	1	0	0.4
Nutrients removed								
As animal products	20	3	1	3	7	0	1	0.0
As supplements	0	0	0	0	0	0	0	0.0
Net transfer by animals	2	0	2	0	0	0	0	0.0
To atmospheric	30	0	0	0	0	0	0	-0.1
To water	44	1.2	12	59	36	16	78	-1.1
Change in internal pools								
Organic pool	137	16	0	1	0	0	0	-0.2
Inorganic mineral	0	4	-3	0	-1	0	-4	0.0
Inorganic soil pool	0	-6	35	0	21	-3	-46	2.1

* Acidity - used in calculation of maintenance lime requirements. A gain in acidity indicates that soil pH will decrease.

General Comments

This page gives some general comments about the outputs. Other block specific information may be available as following reports.

The interpretation of environmental impacts is dependent on regional and catchment based criteria, of which many are still being developed as part of regional and central government policy. The interpretation may also be dependent on other organisations within the supply chain. Therefore it is important that information is sought from these bodies before interpreting the nutrient budget.

Soil P loss status is high. Consider reducing Olsen P levels.

Fertiliser P loss is greater than 10% of total P loss and 1.5 kg P/ha/yr - this is outside the range of data available for New Zealand and P loss data should be used with caution. Potential P loss from fertiliser is high. Check fertiliser rates are not too high. If P is applied in high risk months consider alternative months of application or changing the form of P.

The change in inorganic soil pool indicates that additional fertiliser nutrients may be required to maintain production for Na

Estimated change in soil test values for samples taken to 7.5cm:

Decrease in Olsen P test of 2 units

No change in QT K test

No change in QT Mg test

Soil Na status is slowly declining. Check pasture Na status, especially on pumice soil, to ascertain need for Na supplementation.

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Block Nutrient Budget - Pastoral pond slurry a

Soil is slowly acidifying and would be neutralised by a maintenance lime application of 100 kg/ha/yr pure lime. Review soil pH and lime requirement.

Version 6.2.2, on 2016-08-30 06:50:57

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Block Nutrient Budget - Pastoral buffer zones

	N	P	K	S	Ca	Mg	Na	H+*
				(kg/ha/yr)				
Nutrients added								
Fertiliser, lime & organic	0	0	0	0	0	0	0	0.0
Rain/clover N fixation	63	0	2	3	2	4	12	0.3
Irrigation	0	0	0	0	0	0	0	0.0
Supplements fed on block	0	0	0	0	0	0	0	0.0
Nutrients removed								
As animal products	16	3	1	2	6	0	1	0.0
As supplements	0	0	0	0	0	0	0	0.0
Net transfer by animals	2	0	1	0	0	0	0	0.0
To atmospheric	19	0	0	0	0	0	0	0.0
To water	14	1.4	12	14	12	14	81	-0.6
Change in internal pools								
Organic pool	13	11	0	-13	0	0	0	-0.1
Inorganic mineral	0	2	-6	0	-1	0	-4	0.0
Inorganic soil pool	0	-17	-6	0	-15	-9	-66	1.0

* Acidity - used in calculation of maintenance lime requirements. A gain in acidity indicates that soil pH will decrease.

General Comments

This page gives some general comments about the outputs. Other block specific information may be available as following reports.

The interpretation of environmental impacts is dependent on regional and catchment based criteria, of which many are still being developed as part of regional and central government policy. The interpretation may also be dependent on other organisations within the supply chain. Therefore it is important that information is sought from these bodies before interpreting the nutrient budget.

Soil P loss status is high. Consider reducing Olsen P levels.

Fertiliser P loss is greater than 10% of total P loss and 1.5 kg P/ha/yr - this is outside the range of data available for New Zealand and P loss data should be used with caution. Potential P loss from fertiliser is high. Check fertiliser rates are not too high. If P is applied in high risk months consider alternative months of application or changing the form of P.

The change in inorganic soil pool indicates that additional fertiliser nutrients may be required to maintain production for Na

Estimated change in soil test values for samples taken to 7.5cm:

Decrease in Olsen P test of 4 units

Decrease in QT K test of 1 units

Decrease in QT Mg test of 1 units

Soil Mg status is slowly declining. Mg containing fertiliser will eventually be needed to maintain current production.

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Block Nutrient Budget - Pastoral buffer zones

Soil Na status is slowly declining. Check pasture Na status, especially on pumice soil, to ascertain need for Na supplementation.

Soil is slowly acidifying and would be neutralised by a maintenance lime application of 50 kg/ha/yr pure lime. Review soil pH and lime requirement.

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Block Nutrient Budget - Trees and scrub

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added							
Rain/clover N fixation	3	0	2	3	2	4	12
Nutrients removed							
To water	3	0.1	2	3	2	4	12
Change in internal pools							
Inorganic mineral	0	0	0	0	0	0	0

* Acidity - used in calculation of maintenance lime requirements. A gain in acidity indicates that soil pH will decrease.

General Comments

There are no comments for this report.

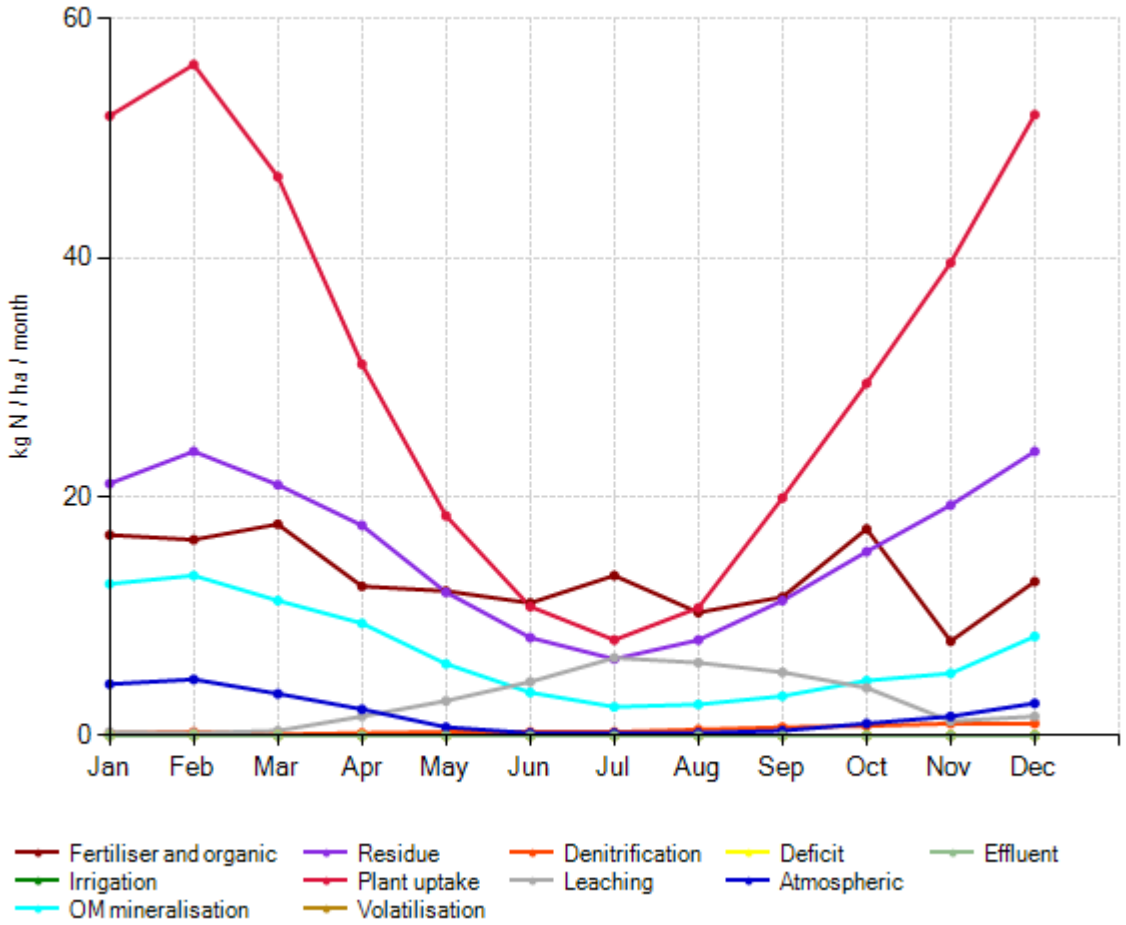
Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Change in N Pools for block - Pastoral irrigat



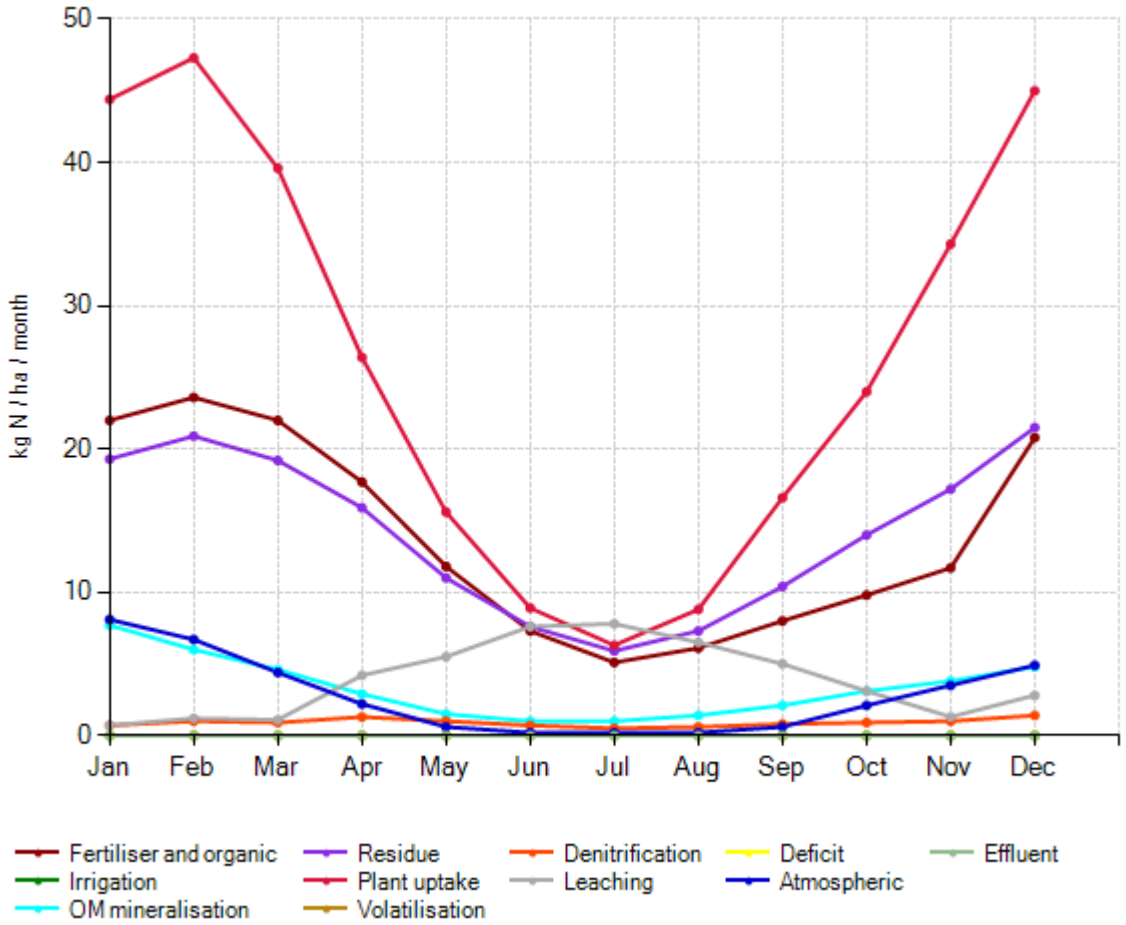
Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Change in N Pools for block - Pastoral manu



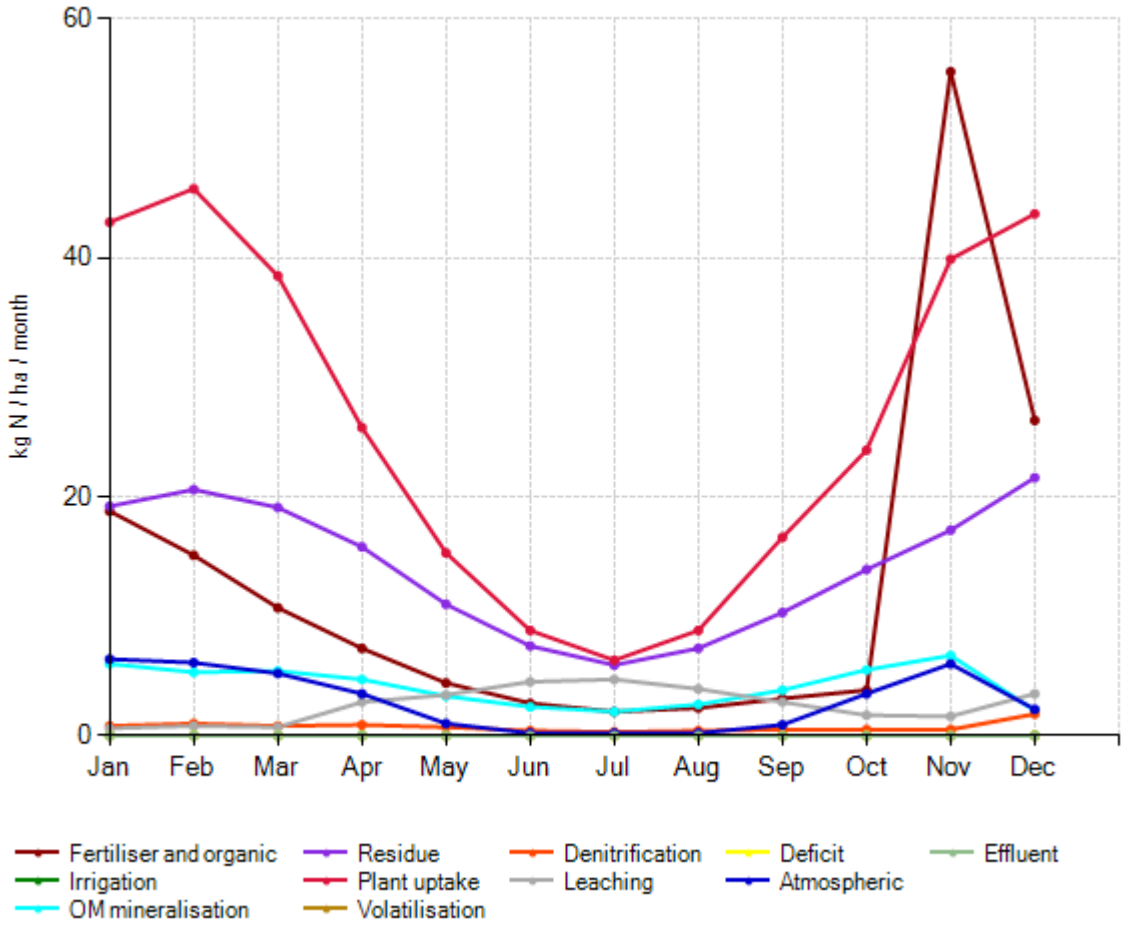
Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Change in N Pools for block - Pastoral pond



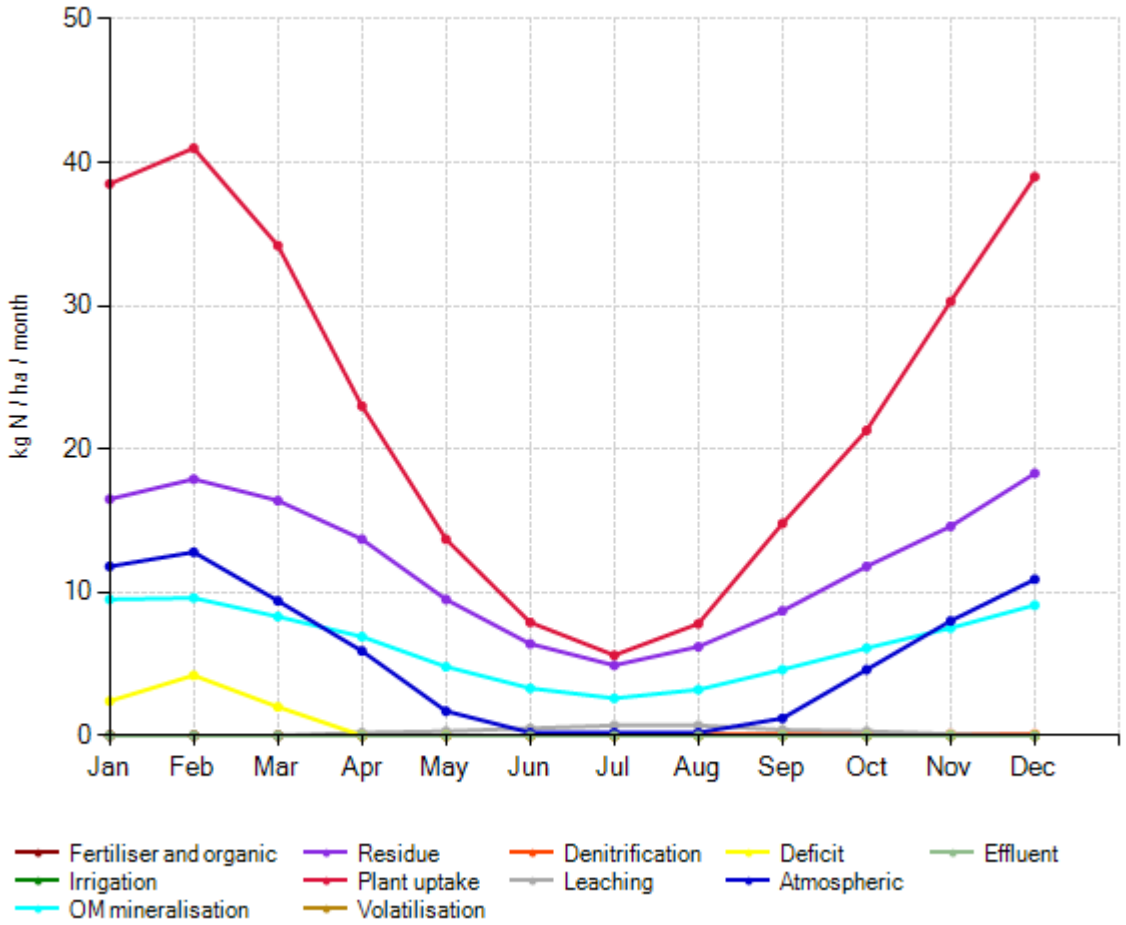
Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Change in N Pools for block - Pastoral buffer



Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Other values for farm - Tutaki Block - Scenari

Percent male beef animals	86
Total liveweight brought (kg/ha grazed)	693
Total liveweight reared (kg/ha grazed)	382
Total liveweight sold (kg/ha grazed)	1103
$ on fertiliser per ha	$0.00
GHG: Allocation to wool - breeding mob	0.05
GHG: Allocation to wool - trading mob	0.02
Sheep stock rate (RSU)	1224
Beef / dairy grazing stock rate (RSU)	656

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Other values for block - Pastoral irrigated

Relative yield (from soil tests & fertiliser)	68
Pasture utilisation (%)	70
Annual average temperature (C)	10.9
Annual rainfall (mm/yr)	1646
Annual irrigation supplied (mm/yr)	0
Added to pasture (mm/yr)	0
Annual AET (mm/yr)	627
Annual drainage (mm/yr)	1154
Annual runoff (mm/yr)	65
Field capacity (mm to 60 cm)	222
Wilting point (mm to 60 cm)	93
Saturation (mm to 60 cm)	408
Profile available water (PAW) (mm to 60 cm)	129
$ on fertiliser per ha	$0.00
$ on fertiliser equivalent of organic per ha	$956.40
Urine N risk index	21.6

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Other values for block - Pastoral manure slur

Relative yield (from soil tests & fertiliser)	57
Pasture utilisation (%)	70
Annual average temperature (C)	10.9
Annual rainfall (mm/yr)	1646
Annual irrigation supplied (mm/yr)	0
Added to pasture (mm/yr)	0
Annual AET (mm/yr)	631
Annual drainage (mm/yr)	965
Annual runoff (mm/yr)	49
Field capacity (mm to 60 cm)	231
Wilting point (mm to 60 cm)	96
Saturation (mm to 60 cm)	402
Profile available water (PAW) (mm to 60 cm)	135
$ on fertiliser per ha	$0.00
$ on fertiliser equivalent of organic per ha	$657.67
Urine N risk index	17.4

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Other values for block - Pastoral pond slurry

Relative yield (from soil tests & fertiliser)	57
Pasture utilisation (%)	70
Annual average temperature (C)	10.9
Annual rainfall (mm/yr)	1646
Annual irrigation supplied (mm/yr)	0
Added to pasture (mm/yr)	0
Annual AET (mm/yr)	627
Annual drainage (mm/yr)	969
Annual runoff (mm/yr)	50
Field capacity (mm to 60 cm)	231
Wilting point (mm to 60 cm)	96
Saturation (mm to 60 cm)	402
Profile available water (PAW) (mm to 60 cm)	135
$ on fertiliser per ha	$0.00
$ on fertiliser equivalent of organic per ha	$458.42
Urine N risk index	16.3

Crusader Meats NZ Ltd

Albert van Oostrom
Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Other values for block - Pastoral buffer zones

Relative yield (from soil tests & fertiliser)	50
Pasture utilisation (%)	70
Annual average temperature (C)	10.9
Annual rainfall (mm/yr)	1646
Annual irrigation supplied (mm/yr)	0
Added to pasture (mm/yr)	0
Annual AET (mm/yr)	631
Annual drainage (mm/yr)	908
Annual runoff (mm/yr)	107
Field capacity (mm to 60 cm)	222
Wilting point (mm to 60 cm)	93
Saturation (mm to 60 cm)	408
Profile available water (PAW) (mm to 60 cm)	129
$ on fertiliser per ha	$0.00
Urine N risk index	14.5

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Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

Farm details

Type	Farm type	Full range
Assessment	Assessment year	Not entered
Region	Region	Waikato/Coromandel

Farm blocks

Pastoral irrigated	Pastoral	97.6
Pastoral manure slurry appln	Pastoral	6.6
Pastoral buffer zones	Pastoral	65
Pastoral pond slurry appln	Pastoral	7.2
Trees and scrub	Trees and Scrub	14
Total farm area declared in blocks	ha	190.4
Total farm area	ha	222.5
Non-productive area	ha	32.1

Farm animals

Stock numbers

Stock reconciliation - Sheep

Stock production

Lambing percentage	%	120
Percent replacements	%	20
Mean lambing date		Not entered
Mean weaning date		Not entered
Weaning weight	kg	Not entered
Wool production	kg/yr	Not entered

Stock numbers

Mob name	Class	Breed	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Lambs	Lambs	Romney	388	364	355	0	0	0	0	0	0	0	0	0
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	10	On-farm	Sold to store	MixedSex						
Lambs	Lambs	Romney	0	0	170	161	161	161	161	155	114	0	0	0
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	1	On-farm	Sold to store	MixedSex						
Lambs	Lambs	Romney	0	0	0	0	0	0	95	95	95	0	0	0
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	4	Brought	Sold to store	MixedSex						
Lambs	Lambs	Romney	0	0	0	0	0	0	0	0	0	848	846	652
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	7	Brought	Sold to store	MixedSex						
Lambs	Lambs	Romney	0	0	0	0	0	0	0	0	0	0	502	492
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	8	Brought	Sold to store	MixedSex						
BreedingRams	BreedingRams	Romney	2	2	1	1	1	1	1	1	1	5	5	5
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					
0	0	0	0	0			Male						
BreedingEwesMixedAge	BreedingEwesMixedAge	Romney	154	151	149	144	82	999	1948	3937	2032	634	428	420
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)	Source	Fate	Sex	Mated					

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Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

0	0	0	0	0	Female

Stock reconciliation - Beef / dairy grazing

Stock production

Calving percentage	%	Not entered
Percent replacements	%	Not entered
Mean calving date		Not entered
Mean weaning date		Not entered
Weaning weight	kg	Not entered

Stock numbers

Mob name	Class	Breed	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
HeifersAndCows	HeifersAndCows	Angus	61	61	61	61	11	11	11	11	11	11	11	0
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)		Source	Fate	Sex		Mated			
0	0	0	0	9		On-farm	Sold to store	Female					
Steers	Steers	Angus	3	3	3	3	125	125	140	140	140	140	140	140
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)		Source	Fate	Sex		Mated			
0	0	0	0	9		On-farm	Remain on-farm	Castrated					
Steers	Steers	Angus	41	41	41	41	2	2	2	2	2	2	2	0
Max weight (kg)	LW start (kg)	LW end (kg)	CW (kg)	Age (months)		Source	Fate	Sex		Mated			
0	0	0	0	21		On-farm	Sold to store	Castrated					

Animal excreta distribution

Relative productivity assessment method	Relative yield (from soil, fertiliser inputs)

Relative productivity calculated for each Pastoral block

Pastoral irrigated	0.676100454512161
Pastoral manure slurry appln	0.572782331300863
Pastoral buffer zones	0.500737090897317
Pastoral pond slurry appln	0.572782331300863

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

Animal health supplements

Animal - Sheep

No animal supplementation has been entered

Animal - Beef / dairy grazing

No animal supplementation has been entered

Left over feeding

No left over feeding specified
No supplements from storage added to this farm
No supplements imported onto this farm

Block Information

Block - Pastoral irrigated

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Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

Block - Pastoral irrigated

Block name		Pastoral irrigated
Block type		Pastoral
Area	ha	97.6
Relative productivity		0
Pasture block type		No
Topography		Rolling
Distance from coast	km	71
Cultivated in last 5 years		True
Climate		
Annual average rainfall	mm/yr	1646
Mean annual temperature		10.9
Seasonal variation in rainfall		1450-2900 mm, Moderate
Annual potential evapotranspiration		651-800 mm/yr
Seasonal variation in PET		Moderate
Soil description		
Soil order (default)		Podzol
Soil group (default)		Podzol
SMaps	Sibling	Maro_11a.1
Date downloaded		2016 August 19 01:32
Wilting point	0 - 30cm	15
	30 - 60cm	16
	> 60	19
Field capacity	0 - 30cm	35
	30 - 60cm	39
	> 60	45
Saturation	0 - 30cm	70
	30 - 60cm	66
	> 60	66
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0
Depth to impeded layer	cm	0
Soil texture group		Light
Non-standard layer		
Depth to non-standard layer	cm	0
Top soil horizon chemical and physical parameters		
ASC/PR		42
Sand	%	65
Natural drainage class		Well
Bulk density	kg/m^3	1090
Clay	%	12
Sub soil clay	%	11
Soil profile		
Compacted top soil		False
Stony top soil		False
Depth to impeded drainage layer		0
Maximum rooting depth	m	0
Top soil texture		Unknown

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Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

Top soil texture					Unknown
Soil drainage					
Profile drainage class					Use default
Hydrophobic condition					Rain always soaks in
Drainage method					
Method					None
Soil settings					
K leaching potential not set					
N immobilisation status					Standard
Soil tests					
Olsen P	QT K	QT Ca	QT Mg	QT Na	
18	6	5	10	7	
Organic S					7
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
Supplements removed					
Supplement information					
Conservation type					Silage
Name					
Pasture type					
Wrapping					Wrapped in plastic
Supplement amount					
Number of bales			T		300
Packaging					Round bales
Bale size					
Dimensions					H: 120 R: 120
Fed on blocks: Pastoral irrigated, Pastoral manure slurry appln, Pastoral pond slurry appln,					
No feeding destinations found					
Supplement information					
Conservation type					Silage
Name					
Pasture type					
Wrapping					Wrapped in plastic
Supplement amount					
Number of bales			T		500
Packaging					Round bales

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Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

Packaging	Round bales
Bale size	
Dimensions	H: 120 R: 120
Supplement is exported from the farm	
Fertiliser application	
Other nutrient inputs - July	
Description	Anaerobic pond effluent
Source	Custom effluent
Rate	167382
Other nutrient inputs - August	
Description	Anaerobic pond effluent
Source	Custom effluent
Rate	129132
Other nutrient inputs - September	
Description	Anaerobic pond effluent
Source	Custom effluent
Rate	144509
Other nutrient inputs - October	
Description	Anaerobic pond effluent
Source	Custom effluent
Rate	216206
Other nutrient inputs - November	
Description	Anaerobic pond effluent
Source	Custom effluent
Rate	98494
Other nutrient inputs - December	
Description	Anaerobic pond effluent
Source	Custom effluent
Rate	161718
Other nutrient inputs - January	
Description	Anaerobic pond effluent
Source	Custom effluent
Rate	209622
Other nutrient inputs - February	

Parameters

Other nutrient inputs - February

Description	Anaerobic pond effluent
Source	Custom effluent
Rate	204559

Other nutrient inputs - March

Description	Anaerobic pond effluent
Source	Custom effluent
Rate	221558

Other nutrient inputs - April

Description	Anaerobic pond effluent
Source	Custom effluent
Rate	156223

Other nutrient inputs - May

Description	Anaerobic pond effluent
Source	Custom effluent
Rate	151404

Other nutrient inputs - June

Description	Anaerobic pond effluent
Source	Custom effluent
Rate	139192

Previous lime applications

Lime material		McDonalds lime
Rate	kg/ha	1000
Dissolves within the year		False
Years since lime applied		2

Irrigation

No irrigation entered

Irrigation concentrations

N	P	K	S	Ca	Mg	Na	H
0	0	0	0	0	0	0	0

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

Sheep	%	0

Block intensity

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Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

Merino		False
Animal grazing		
Sheep graze block all year round		
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 manure slurry appln

Block name		Pastoral manure slurry appln
Block type		Pastoral
Area	ha	6.6
Relative productivity		0
Pasture block type		No
Topography		Rolling
Distance from coast	km	71
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1646
Mean annual temperature		10.9
Seasonal variation in rainfall		1450-2900 mm, Moderate
Annual potential evapotranspiration		651-800 mm/yr
Seasonal variation in PET		Low
Soil description		
Soil order (default)		Podzol
Soil group (default)		Podzol
SMaps	Sibling	Ngong_10a.1
Date downloaded		2016 August 24 04:27
Wilting point	0 - 30cm	21
	30 - 60cm	11
	> 60	17
Field capacity	0 - 30cm	41
	30 - 60cm	36
	> 60	39
Saturation	0 - 30cm	70
	30 - 60cm	64
	> 60	68

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Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

	> 60	68
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0
Depth to impeded layer	cm	0
Soil texture group		Light
Non-standard layer		
Depth to non-standard layer	cm	0

Top soil horizon chemical and physical parameters

ASC/PR		42
Sand	%	55
Natural drainage class		Well
Bulk density	kg/m^3	1090
Clay	%	12
Sub soil clay	%	11

Soil profile

Compacted top soil		False
Stony top soil		False
Depth to impeded drainage layer		0
Maximum rooting depth	m	0
Top soil texture		Unknown

Soil drainage

Profile drainage class	Use default
Hydrophobic condition	Use default

Drainage method

Method	None

Soil settings

K leaching potential not set	
N immobilisation status	Standard

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
11	4	5	8	4

Organic S	7
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

Supplements removed

No supplements removed from this block

Fertiliser application

Parameters

Other nutrient inputs - July		
Description		Manure slurry
Rate		10
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - August		
Description		Manure slurry
Rate		10
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - September		
Description		Manure slurry
Rate		10
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - October		
Description		Manure slurry
Rate		10
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - November		
Description		Manure slurry
Rate		21
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - December		
Description		Manure slurry
Rate		83
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - January		
Description		Manure slurry
Rate		83
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - February		

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Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

Other nutrient inputs - February		
Description		Manure slurry
Rate		83
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - March		
Description		Manure slurry
Rate		83
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - April		
Description		Manure slurry
Rate		62
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - May		
Description		Manure slurry
Rate		41
DM content	%	8
Percentage N in organic form		15
Other nutrient inputs - June		
Description		Manure slurry
Rate		20
DM content	%	8
Percentage N in organic form		15
Previous lime applications		
Lime material		McDonalds lime
Rate	kg/ha	1000
Dissolves within the year		False
Years since lime applied		2

Irrigation

No irrigation entered

Irrigation concentrations

N	P	K	S	Ca	Mg	Na	H
0	0	0	0	0	0	0	0

Animals on block

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

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Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

Animals grazing		
Sheep	%	0
Block intensity		
Merino		False
Animal grazing		
Sheep graze block all year round		
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 buffer zones

Block name		Pastoral buffer zones
Block type		Pastoral
Area	ha	65
Relative productivity		0
Pasture block type		No
Topography		Easy hill
Distance from coast	km	71
Cultivated in last 5 years		False
Climate		
Annual average rainfall	mm/yr	1646
Mean annual temperature		10.9
Seasonal variation in rainfall		1450-2900 mm, Moderate
Annual potential evapotranspiration		651-800 mm/yr
Seasonal variation in PET		Low
Soil description		
Soil order (default)		Podzol
Soil group (default)		Podzol
SMaps	Sibling	Maro_11a.1
Date downloaded		2016 August 19 01:32
Wilting point	0 - 30cm	15
	30 - 60cm	16
	> 60	19
Field capacity	0 - 30cm	35

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Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

Field capacity	0 - 30cm	39
	30 - 60cm	39
	> 60	45
Saturation	0 - 30cm	70
	30 - 60cm	66
	> 60	66
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0
Depth to impeded layer	cm	0
Soil texture group		Light
Non-standard layer		
Depth to non-standard layer	cm	0

Top soil horizon chemical and physical parameters

ASC/PR		42
Sand	%	65
Natural drainage class		Well
Bulk density	kg/m^3	1090
Clay	%	12
Sub soil clay	%	11

Soil profile

Compacted top soil		False
Stony top soil		False
Depth to impeded drainage layer		0
Maximum rooting depth	m	0
Top soil texture		Unknown

Soil drainage

Profile drainage class	Use default
Hydrophobic condition	Use default

Drainage method

Method	None

Soil settings

K leaching potential not set	
N immobilisation status	Standard

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
7	4	3	7	4

Organic S	7
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
Supplements removed	

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Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

Supplements removed
No supplements removed from this block

Fertiliser application
No fertiliser application applied on block

Irrigation
No irrigation entered

Irrigation concentrations

N	P	K	S	Ca	Mg	Na	H
0	0	0	0	0	0	0	0

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

Sheep	%	0

Block intensity

Merino		False

Animal grazing
Sheep graze block all year round

Animals grazing

Beef / dairy grazing	%	0

Block intensity

Finishing beef		False

Water connectivity

Direct access to streams		True

Animal grazing
Beef / dairy grazing graze block all year round

Effluent application

Receives no liquid or solid effluents

Block - Pastoral pond slurry appln

Block name		Pastoral pond slurry appln
Block type		Pastoral
Area	ha	7.2
Relative productivity		0
Pasture block type		No
Topography		Rolling
Distance from coast	km	71
Cultivated in last 5 years		False

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Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

Climate		
Annual average rainfall	mm/yr	1646
Mean annual temperature		10.9
Seasonal variation in rainfall		1450-2900 mm, Moderate
Annual potential evapotranspiration		651-800 mm/yr
Seasonal variation in PET		Moderate
Soil description		
Soil order (default)		Podzol
Soil group (default)		Podzol
SMaps	Sibling	Ngong_10a.1
Date downloaded		2016 August 24 04:27
Wilting point	0 - 30cm	21
	30 - 60cm	11
	> 60	17
Field capacity	0 - 30cm	41
	30 - 60cm	36
	> 60	39
Saturation	0 - 30cm	70
	30 - 60cm	64
	> 60	68
Top soil texture		Unknown
Is Stony		False
Maximum rooting depth	cm	0
Depth to impeded layer	cm	0
Soil texture group		Light
Non-standard layer		
Depth to non-standard layer	cm	0
Top soil horizon chemical and physical parameters		
ASC/PR		42
Sand	%	55
Natural drainage class		Well
Bulk density	kg/m^3	1090
Clay	%	12
Sub soil clay	%	11
Soil profile		
Compacted top soil		False
Stony top soil		False
Depth to impeded drainage layer		0
Maximum rooting depth	m	0
Top soil texture		Unknown
Soil drainage		
Profile drainage class		Use default
Hydrophobic condition		Rain always soaks in
Drainage method		
Method		None

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Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

Soil settings
K leaching potential not set

N immobilisation status	Standard

Soil tests

Olsen P	QT K	QT Ca	QT Mg	QT Na
11	4	5	8	4

Organic S	7
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

Supplements removed
No supplements removed from this block

Fertiliser application

Other nutrient inputs - November

Description		Effluent pond slurry
Rate		2000
DM content	%	3
Percentage N in organic form		15

Previous lime applications

Lime material		McDonalds lime
Rate	kg/ha	1000
Dissolves within the year		False
Years since lime applied		2

Irrigation
No irrigation entered

Irrigation concentrations

N	P	K	S	Ca	Mg	Na	H
0	0	0	0	0	0	0	0

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

Sheep	%	0

Block intensity

Merino	False

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Hamilton

Client reference:

Farm name: Tutaki Block - Scenario 2

Parameters

Animal grazing
Sheep graze block all year round

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 - Trees and scrub

Block name		Trees and scrub
Block type		Trees and Scrub
Area	ha	14
Rainfall	mm/yr	1646
Distance from coast	km	71
Bush type		Native

Report settings

Greenhouse gas emission report units: CO2 equivalents (kg/ha)
Target N application rate as effluent: kg N/ha/yr

Fertiliser costs $/kg nutrient

N	P	K	S	Ca	Mg	Na
1.4800000190 7349	2.7599999904 6326	1.4500000476 8372	0.6299999952 31628	0.1000000014 90116	1.4600000381 4697	0.8000000119 20929

Appendix 4. S-map Soil Reports

S-map Soil Report

Report generated: 29-May-2016 from http://smap.landcareresearch.co.nz

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks.

Orua*f*

Podzolic Orthic Pumice Soil

Orua_9a.1 (70% of the mapunit at location (5734706, 1813752), Confidence: Medium)

Key physical properties

Depth class (diggability)		Deep (> 1 m)
Texture profile		Sandy Loam
Potential rooting depth		Unlimited
Rooting barrier		No significant barrier within 1 m
Topsoil stoniness		Stoneless
Topsoil clay range		5 - 8 %
Drainage class		Well drained
Aeration in root zone		Unlimited
Permeability profile		Rapid
Depth to slowly permeable horizon		No slowly permeable horizon
Permeability of slowest horizon		Rapid (> 72 mm/h)
Profile available water	(0 - 100cm or root barrier)	Moderate to high (144 mm)
	(0 - 60cm or root barrier)	Moderate (89 mm)
	(0 - 30cm or root barrier)	Moderate (47 mm)
Dry bulk density, topsoil		0.85 g/cm³
Dry bulk density, subsoil		0.85 g/cm³
Depth to hard rock		No hard rock within 1 m
Depth to soft rock		No soft rock within 1 m
Depth to stony layer class		No significant stony layer within 1 m

Key chemical properties

Topsoil P retention	Medium (51%)

About this publication

- This information sheet describes the *typical average properties* of the specified soil to a depth of 1 metre.
- For further information on individual soils, contact Landcare Research New Zealand Ltd: www.landcareresearch.co.nz
- Advice should be sought from soil and land use experts before making decisions on individual farms and paddocks.
- The information has been derived from numerous sources. It may not be complete, correct or up to date.
- This information sheet is licensed by Landcare Research on an "as is" and "as available" basis and without any warranty of any kind, either express or implied.
- Landcare Research shall not be liable on any legal basis (including without limitation negligence) and expressly excludes all liability for loss or damage howsoever and whenever caused to a user of this factsheet.

Oruaf

S-map ref: Orua_9a.1

Orua_9a.1 (70% of the mapunit at location (5734706, 1813752), Confidence: Medium)

Additional factors to consider in choice of management practices

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability	Moderate (0.54)
Pugging vulnerability	not available yet

Water management

Water logging vulnerability	Very low
Drought vulnerability - if not irrigated	Low
Bypass flow	Medium
Hydrological soil group	A
Irrigability	Gently undulating land with good drainage/permeability and soils with moderate PAW

Contaminant management

N leaching vulnerability	Medium
P leaching vulnerability	not available yet
Bypass flow	Medium
Dairy effluent (FDE) risk category	E
Relative Runoff Potential	Very Low

Additional information

Soil classification	Podzolic Orthic Pumice Soils
Family	Oruaf
Sibling number	9
Profile texture group	Sandy
Soil profile material	Tephric soil
Rock class of stones/rocks	From Rhyolitic Rock
Rock origin of fine earth	From Rhyolitic Rock
Parent material origin	Tephra

Characteristics of functional horizons in order from top to base of profile:

Functional Horizon	Thickness	Stones	Clay*	Sand*
Sandy Loose, Acidic Tephric	6 - 10 cm	0 - 5 %	5 - 8 %	92 - 95 %
Stony (lapilli) Sandy Weak, Acidic Tephric	25 - 30 cm	60 - 70 %	2 - 6 %	92 - 95 %
Stony (lapilli) Sandy Slightly Firm, Acidic Tephric	60 - 70 cm	5 - 30 %	2 - 6 %	92 - 95 %

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

Oruaf

S-map ref: Orua_9a.1

Orua_9a.1 (70% of the mapunit at location (5734706, 1813752), Confidence: Medium)

Soil information for OVERSEER

The following information can be entered in the OVERSEER® Nutrient Budget model. This information is derived from the S-map soil properties which are matched to the most appropriate OVERSEER categories. Please read the notes below for further information.

Soil description page

Click the 'Soil moisture values' option. Enter in the 'Sibling name': Orua_9a.1

From the 'Soil order' dropdown box select: Pumice

Soil water properties	0-30 cm	30-60 cm	> 60 cm	
Wilting point (15 bar)	10	8	8	mm per 10 cm
Field capacity	26	22	22	mm per 10 cm
Saturation	60	60	60	mm per 10 cm

From the 'Natural drainage class' dropdown box select: Well drained

Depth to impeded drainage layer: Enter zero (no impermeable layer above 1m)

Maximum rooting depth: Enter zero (no rooting barrier above 1m)

Top soil horizon chemical and physical parameters

Anion storage capacity (ASC) or phospate retention (PR): 51 %

Bulk density: 850 kg/m³

Clay: 6 %

Sand: 93 %

Sub soil [average from 10 to 30 cm]

Subsoil clay: 4 %

Is compacted
(this depends on management so cannot be obtained from S-map)

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Landcare Research datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.

- Each value is an estimate of the water content of the whole soil within the target depth range or to the depth of the root barrier (if this occurs above the base of the target depth). Where soil layers contain stones, the soil water content has been decreased according to the stone content.

- S-map only contains information on soils to a depth of 100 cm. The soil water estimates in the > 60 cm depth category assume that the bottom functional horizon that extends to 100 cm, continues down to a depth of 150cm. Where it is known by the user that there is an impermeable layer or non-fractured bedrock between 100 and 150 cm, this depth should be entered into OVERSEER. Where there is a change in the soil profile characteristics below 100 cm, the user should be aware that the values provided on this factsheet for the > 60 cm depth category will not reflect this change. For example, the presence of gravels at 120 cm would usually result in lower soil water estimates in the > 60 cm depth category. Note though that this assumption only impacts on a cropping block, as OVERSEER uses soil data from just the top 60 cm in pastoral blocks.

- OVERSEER requires the soil water values to be non-zero integers (even though zero is a valid value below a root barrier), and the wilting point value must be less than the field capacity value which must be less than the saturation value. The S-map water content estimates provided on this page have been rounded to integers and may be assigned minimal values to meet these OVERSEER requirements. These modifications will result in a slightly less accurate estimate of Available Water to 60 cm (labelled PAW in OVERSEER) than that provided on the first page of this factsheet, but this is not expected to lead to any significant difference in outputs from OVERSEER.

Landcare Research Manaaki Whenua

S-map Soil Report

Report generated: 29-May-2016 from http://smap.landcareresearch.co.nz

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks.

Maroa*f*

Humose Orthic Podzol

Maro_11a.1 (70% of the mapunit at location (5733702, 1813063), Confidence: Low)

Key physical properties

Depth class (diggability)		Deep (> 1 m)
Texture profile		Loam Over Sandy Loam
Potential rooting depth		Unlimited
Rooting barrier		No significant barrier within 1 m
Topsoil stoniness		Moderately stony
Topsoil clay range		10 - 15 %
Drainage class		Well drained
Aeration in root zone		Unlimited
Permeability profile		Moderate
Depth to slowly permeable horizon		No slowly permeable horizon
Permeability of slowest horizon		Moderate (4 - 72 mm/h)
Profile available water	(0 - 100cm or root barrier)	High (233 mm)
	(0 - 60cm or root barrier)	Very high (128 mm)
	(0 - 30cm or root barrier)	High (59 mm)
Dry bulk density, topsoil		1.09 g/cm³
Dry bulk density, subsoil		1.42 g/cm³
Depth to hard rock		No hard rock within 1 m
Depth to soft rock		No soft rock within 1 m
Depth to stony layer class		No significant stony layer within 1 m

Key chemical properties

Topsoil P retention	Medium (42%)

About this publication

- This information sheet describes the *typical average properties* of the specified soil to a depth of 1 metre.
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- Advice should be sought from soil and land use experts before making decisions on individual farms and paddocks.
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- This information sheet is licensed by Landcare Research on an "as is" and "as available" basis and without any warranty of any kind, either express or implied.
- Landcare Research shall not be liable on any legal basis (including without limitation negligence) and expressly excludes all liability for loss or damage howsoever and whenever caused to a user of this factsheet.

Maroa*f*

S-map ref: Maro_11a.1

Maro_11a.1 (70% of the mapunit at location (5733702, 1813063), Confidence: Low)

Additional factors to consider in choice of management practices

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability	Moderate (0.53)
Pugging vulnerability	not available yet

Water management

Water logging vulnerability	Very low
Drought vulnerability - if not irrigated	Low
Bypass flow	High
Hydrological soil group	A
Irrigability	Strongly rolling land with good drainage/permeability and soils with high to very high PAW

Contaminant management

N leaching vulnerability	Low
P leaching vulnerability	not available yet
Bypass flow	High
Dairy effluent (FDE) risk category	C
Relative Runoff Potential	Very Low

Additional information

Soil classification	Humose Orthic Podzols
Family	Maroa*f*
Sibling number	11
Profile texture group	Loamy
Soil profile material	Tephric soil
Rock class of stones/rocks	From Rhyolitic Rock
Rock origin of fine earth	From Rhyolitic And Andesite Rock
Parent material origin	Tephra

Characteristics of functional horizons in order from top to base of profile:

Functional Horizon	Thickness	Stones	Clay*	Sand*
Stony (lapilli) Loamy Weak, Acidic Tephric	8 - 15 cm	5 - 15 %	10 - 15 %	60 - 70 %
Stony (lapilli) Sandy Loose, Acidic Tephric	25 - 30 cm	25 - 35 %	1 - 5 %	80 - 90 %
Loamy Weak, Acidic Tephric	55 - 70 cm	0 %	20 - 25 %	20 - 30 %

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

Maroa*f*

S-map ref: Maro_11a.1

Maro_11a.1 (70% of the mapunit at location (5733702, 1813063), Confidence: Low)

Soil information for OVERSEER

The following information can be entered in the OVERSEER® Nutrient Budget model. This information is derived from the S-map soil properties which are matched to the most appropriate OVERSEER categories. Please read the notes below for further information.

Soil description page

Click the 'Soil moisture values' option. Enter in the 'Sibling name': Maro_11a.1

From the 'Soil order' dropdown box select: Podzol

Soil water properties	0-30 cm	30-60 cm	> 60 cm	
Wilting point (15 bar)	15	16	19	mm per 10 cm
Field capacity	35	39	45	mm per 10 cm
Saturation	70	66	66	mm per 10 cm

From the 'Natural drainage class' dropdown box select: Well drained

Depth to impeded drainage layer: Enter zero (no impermeable layer above 1m)

Maximum rooting depth: Enter zero (no rooting barrier above 1m)

Top soil horizon chemical and physical parameters

Anion storage capacity (ASC) or phospate retention (PR): 42 %

Bulk density: 1090 kg/m³

Clay: 12 %

Sand: 65 %

Sub soil [average from 10 to 30 cm]

Subsoil clay: 3 %

Is compacted
(this depends on management so cannot be obtained from S-map)

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Landcare Research datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.

- Each value is an estimate of the water content of the whole soil within the target depth range or to the depth of the root barrier (if this occurs above the base of the target depth). Where soil layers contain stones, the soil water content has been decreased according to the stone content.

- S-map only contains information on soils to a depth of 100 cm. The soil water estimates in the > 60 cm depth category assume that the bottom functional horizon that extends to 100 cm, continues down to a depth of 150cm. Where it is known by the user that there is an impermeable layer or non-fractured bedrock between 100 and 150 cm, this depth should be entered into OVERSEER. Where there is a change in the soil profile characteristics below 100 cm, the user should be aware that the values provided on this factsheet for the > 60 cm depth category will not reflect this change. For example, the presence of gravels at 120 cm would usually result in lower soil water estimates in the > 60 cm depth category. Note though that this assumption only impacts on a cropping block, as OVERSEER uses soil data from just the top 60 cm in pastoral blocks.

- OVERSEER requires the soil water values to be non-zero integers (even though zero is a valid value below a root barrier), and the wilting point value must be less than the field capacity value which must be less than the saturation value. The S-map water content estimates provided on this page have been rounded to integers and may be assigned minimal values to meet these OVERSEER requirements. These modifications will result in a slightly less accurate estimate of Available Water to 60 cm (labelled PAW in OVERSEER) than that provided on the first page of this factsheet, but this is not expected to lead to any significant difference in outputs from OVERSEER.

Landcare Research
Manaaki Whenua

S-map Soil Report

Report generated: 29-May-2016 from http://smap.landcareresearch.co.nz

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks.

Ngongotaha*f*

Humose Orthic Podzol

Ngong_10a.1 (60% of the mapunit at location (5733526, 1812689), Confidence: Low)

Key physical properties

Depth class (diggability)		Deep (> 1 m)
Texture profile		Loam
Potential rooting depth		Unlimited
Rooting barrier		No significant barrier within 1 m
Topsoil stoniness		Moderately stony
Topsoil clay range		10 - 15 %
Drainage class		Well drained
Aeration in root zone		Unlimited
Permeability profile		Rapid
Depth to slowly permeable horizon		No slowly permeable horizon
Permeability of slowest horizon		Rapid (> 72 mm/h)
Profile available water	(0 - 100cm or root barrier)	High (223 mm)
	(0 - 60cm or root barrier)	Very high (133 mm)
	(0 - 30cm or root barrier)	High (60 mm)
Dry bulk density, topsoil		1.09 g/cm³
Dry bulk density, subsoil		1.42 g/cm³
Depth to hard rock		No hard rock within 1 m
Depth to soft rock		No soft rock within 1 m
Depth to stony layer class		No significant stony layer within 1 m

Key chemical properties

Topsoil P retention	Medium (42%)

About this publication

- This information sheet describes the *typical average properties* of the specified soil to a depth of 1 metre.
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- Landcare Research shall not be liable on any legal basis (including without limitation negligence) and expressly excludes all liability for loss or damage howsoever and whenever caused to a user of this factsheet.

Ngongotaha*f*

S-map ref: Ngong_10a.1

Ngong_10a.1 (60% of the mapunit at location (5733526, 1812689), Confidence: Low)

Additional factors to consider in choice of management practices

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability	Moderate (0.53)
Pugging vulnerability	not available yet

Water management

Water logging vulnerability	Very low
Drought vulnerability - if not irrigated	Low
Bypass flow	High
Hydrological soil group	A
Irrigability	Rolling land with good drainage/permeability and soils with high to very high PAW

Contaminant management

N leaching vulnerability	Low
P leaching vulnerability	not available yet
Bypass flow	High
Dairy effluent (FDE) risk category	C
Relative Runoff Potential	Very Low

Additional information

Soil classification	Humose Orthic Podzols
Family	Ngongotaha*f*
Sibling number	10
Profile texture group	Loamy
Soil profile material	Tephric soil
Rock class of stones/rocks	From Rhyolitic Rock
Rock origin of fine earth	From Rhyolitic And Andesite Rock
Parent material origin	Tephra

Characteristics of functional horizons in order from top to base of profile:

Functional Horizon	Thickness	Stones	Clay*	Sand*
Loamy Earthy Weak, Acidic Tephric	10 - 15 cm	0 %	10 - 15 %	50 - 60 %
Stony (lapilli) Loamy Weak, Acidic Tephric	20 - 30 cm	20 - 30 %	10 - 20 %	50 - 70 %
Stony (lapilli) Sandy Weak, Acidic Tephric	40 - 60 cm	20 - 30 %	4 - 7 %	50 - 70 %
Loamy Weak, Acidic Tephric	0 - 30 cm	0 %	25 - 35 %	50 - 60 %

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

Ngongotaha*f*

S-map ref: Ngong_10a.1

Ngong_10a.1 (60% of the mapunit at location (5733526, 1812689), Confidence: Low)

Soil information for OVERSEER

The following information can be entered in the OVERSEER® Nutrient Budget model. This information is derived from the S-map soil properties which are matched to the most appropriate OVERSEER categories. Please read the notes below for further information.

Soil description page

Click the 'Soil moisture values' option. Enter in the 'Sibling name': Ngong_10a.1

From the 'Soil order' dropdown box select: Podzol

Soil water properties	0-30 cm	30-60 cm	> 60 cm	
Wilting point (15 bar)	21	11	17	mm per 10 cm
Field capacity	41	36	39	mm per 10 cm
Saturation	70	64	68	mm per 10 cm

From the 'Natural drainage class' dropdown box select: Well drained

Depth to impeded drainage layer: Enter zero (no impermeable layer above 1m)

Maximum rooting depth: Enter zero (no rooting barrier above 1m)

Top soil horizon chemical and physical parameters

Anion storage capacity (ASC) or phospate retention (PR): 42 %

Bulk density: 1090 kg/m³

Clay: 12 %

Sand: 55 %

Sub soil [average from 10 to 30 cm]

Subsoil clay: 15 %

Is compacted
(this depends on management so cannot be obtained from S-map)

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Landcare Research datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.

- Each value is an estimate of the water content of the whole soil within the target depth range or to the depth of the root barrier (if this occurs above the base of the target depth). Where soil layers contain stones, the soil water content has been decreased according to the stone content.

- S-map only contains information on soils to a depth of 100 cm. The soil water estimates in the > 60 cm depth category assume that the bottom functional horizon that extends to 100 cm, continues down to a depth of 150cm. Where it is known by the user that there is an impermeable layer or non-fractured bedrock between 100 and 150 cm, this depth should be entered into OVERSEER. Where there is a change in the soil profile characteristics below 100 cm, the user should be aware that the values provided on this factsheet for the > 60 cm depth category will not reflect this change. For example, the presence of gravels at 120 cm would usually result in lower soil water estimates in the > 60 cm depth category. Note though that this assumption only impacts on a cropping block, as OVERSEER uses soil data from just the top 60 cm in pastoral blocks.

- OVERSEER requires the soil water values to be non-zero integers (even though zero is a valid value below a root barrier), and the wilting point value must be less than the field capacity value which must be less than the saturation value. The S-map water content estimates provided on this page have been rounded to integers and may be assigned minimal values to meet these OVERSEER requirements. These modifications will result in a slightly less accurate estimate of Available Water to 60 cm (labelled PAW in OVERSEER) than that provided on the first page of this factsheet, but this is not expected to lead to any significant difference in outputs from OVERSEER.

Landcare Research
Manaaki Whenua

S-map Soil Report

Report generated: 29-May-2016 from http://smap.landcareresearch.co.nz

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks.

Te Toka*f*

Typic Orthic Pumice Soil

Tetk_4a.1 (100% of the mapunit at location (5733310, 1812519), Confidence: Medium)

Key physical properties

Depth class (diggability)		Deep (> 1 m)
Texture profile		Loam Over Sandy Loam
Potential rooting depth		Unlimited
Rooting barrier		No significant barrier within 1 m
Topsoil stoniness		Moderately stony
Topsoil clay range		10 - 20 %
Drainage class		Well drained
Aeration in root zone		Unlimited
Permeability profile		Rapid
Depth to slowly permeable horizon		No slowly permeable horizon
Permeability of slowest horizon		Rapid (> 72 mm/h)
Profile available water	(0 - 100cm or root barrier)	High (158 mm)
	(0 - 60cm or root barrier)	High (104 mm)
	(0 - 30cm or root barrier)	High (62 mm)
Dry bulk density, topsoil		0.91 g/cm³
Dry bulk density, subsoil		0.85 g/cm³
Depth to hard rock		No hard rock within 1 m
Depth to soft rock		No soft rock within 1 m
Depth to stony layer class		No significant stony layer within 1 m

Key chemical properties

Topsoil P retention	Medium (51%)

About this publication

- This information sheet describes the *typical average properties* of the specified soil to a depth of 1 metre.
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Te Toka*f*

S-map ref: Tetk_4a.1

Tetk_4a.1 (100% of the mapunit at location (5733310, 1812519), Confidence: Medium)

Additional factors to consider in choice of management practices

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability	Low (0.47)
Pugging vulnerability	not available yet

Water management

Water logging vulnerability	Very low
Drought vulnerability - if not irrigated	Low
Bypass flow	Medium
Hydrological soil group	A
Irrigability	Gently undulating land with good drainage/permeability and soils with high PAW

Contaminant management

N leaching vulnerability	Low
P leaching vulnerability	not available yet
Bypass flow	Medium
Dairy effluent (FDE) risk category	D
Relative Runoff Potential	Very Low

Additional information

Soil classification	Typic Orthic Pumice Soils
Family	Te Toka*f*
Sibling number	4
Profile texture group	Loamy
Soil profile material	Tephric soil
Rock class of stones/rocks	From Rhyolitic Rock
Rock origin of fine earth	From Rhyolitic On Hard Sandstone Rock
Parent material origin	Alluvium

Characteristics of functional horizons in order from top to base of profile:

Functional Horizon	Thickness	Stones	Clay*	Sand*
Stony (lapilli) Loamy Weak, Acidic Tephric	18 - 22 cm	20 - 40 %	10 - 20 %	80 - 90 %
Sandy Weak, Acidic Tephric	8 - 10 cm	2 - 10 %	5 - 10 %	90 - 95 %
Stony (lapilli) Sandy Loose, Acidic Tephric	30 - 40 cm	20 - 35 %	1 - 5 %	90 - 95 %
Very Stony (lapilli) Sandy Loose, Acidic Tephric	28 - 44 cm	70 - 80 %	1 - 5 %	90 - 99 %

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

Te Tokaf

S-map ref: Tetk_4a.1

Tetk_4a.1 (100% of the mapunit at location (5733310, 1812519), Confidence: Medium)

Soil information for OVERSEER

The following information can be entered in the OVERSEER® Nutrient Budget model. This information is derived from the S-map soil properties which are matched to the most appropriate OVERSEER categories. Please read the notes below for further information.

Soil description page

Click the 'Soil moisture values' option. Enter in the 'Sibling name': Tetk_4a.1

From the 'Soil order' dropdown box select: Pumice

Soil water properties	0-30 cm	30-60 cm	> 60 cm	
Wilting point (15 bar)	24	7	7	mm per 10 cm
Field capacity	45	21	21	mm per 10 cm
Saturation	69	60	60	mm per 10 cm

From the 'Natural drainage class' dropdown box select: Well drained

Depth to impeded drainage layer: Enter zero (no impermeable layer above 1m)

Maximum rooting depth: Enter zero (no rooting barrier above 1m)

Top soil horizon chemical and physical parameters

Anion storage capacity (ASC) or phospate retention (PR): 51 %

Bulk density: 910 kg/m³

Clay: 15 %

Sand: 85 %

Sub soil [average from 10 to 30 cm]

Subsoil clay: 7 %

Is compacted
(this depends on management so cannot be obtained from S-map)

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Landcare Research datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.

- Each value is an estimate of the water content of the whole soil within the target depth range or to the depth of the root barrier (if this occurs above the base of the target depth). Where soil layers contain stones, the soil water content has been decreased according to the stone content.

- S-map only contains information on soils to a depth of 100 cm. The soil water estimates in the > 60 cm depth category assume that the bottom functional horizon that extends to 100 cm, continues down to a depth of 150cm. Where it is known by the user that there is an impermeable layer or non-fractured bedrock between 100 and 150 cm, this depth should be entered into OVERSEER. Where there is a change in the soil profile characteristics below 100 cm, the user should be aware that the values provided on this factsheet for the > 60 cm depth category will not reflect this change. For example, the presence of gravels at 120 cm would usually result in lower soil water estimates in the > 60 cm depth category. Note though that this assumption only impacts on a cropping block, as OVERSEER uses soil data from just the top 60 cm in pastoral blocks.

- OVERSEER requires the soil water values to be non-zero integers (even though zero is a valid value below a root barrier), and the wilting point value must be less than the field capacity value which must be less than the saturation value. The S-map water content estimates provided on this page have been rounded to integers and may be assigned minimal values to meet these OVERSEER requirements. These modifications will result in a slightly less accurate estimate of Available Water to 60 cm (labelled PAW in OVERSEER) than that provided on the first page of this factsheet, but this is not expected to lead to any significant difference in outputs from OVERSEER.

Landcare Research Manaaki Whenua

Appendix 5. Dairy Effluent Storage Calculator Reports

Dairy Effluent Storage Calculator
Summary Report

Regional authority: Horizons Regional Council
Authorised agent: Albert van Oostrom & Associates
Client: Crusader Meats NZ Ltd
Program version: 1.46
Report date: Friday, 26 August 2016
General description:

Scenario A: Current 900 m³ daily irrigation volume.

Monthly average daily effluent volumes are those irrigated for the period 1/06/2015 to 31/05/2016. They reflect current production levels.

Climate

Rainfall site: Taumarunui
Mean annual rainfall: 1513 mm/year

Effluent Block

Area of low risk soil: 149.9 hectares
Minimum area of high risk soil: 0.0 hectares
Surplus area of high risk soil: 0.0 hectares

Wash Water

Yard wash:

- Milking season starts: 01 August
- Milking season ends: 31 July

Average daily

Month	Number of Cows	Hours in Yard	Wash Volume (cubic metres)
January	0	0.0	534.0
February	0	0.0	504.0
March	0	0.0	438.0
April	0	0.0	529.0
May	0	0.0	456.0
June	0	0.0	557.0
July	0	0.0	598.0
August	0	0.0	452.0
September	0	0.0	439.0
October	0	0.0	452.0
November	0	0.0	235.0
December	0	0.0	458.0

Irrigation

Winter-spring depth: 44 mm
Spring-autumn depth: 45 mm
Winter-spring volume: 900 cubic metres
Spring-autumn volume: 900 cubic metres
Irrigate all year? Yes

Catchments

Yard Area:	1200 square metres
Diverted?	No
Shed Roof Area:	5000 square metres
Diverted?	Yes
Feedpad Area:	0 square metres
Covered?	No
Diverted?	No
Animal Shelter Area:	0 square metres
Covered?	No
Diverted?	No
Other Areas:	0 square metres

Storage

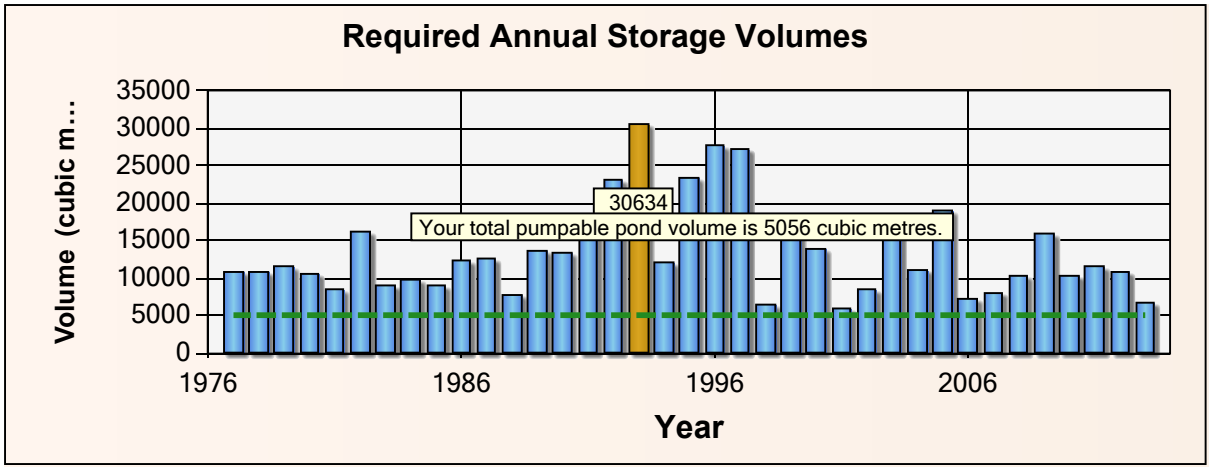
Pond/s present?	Yes
No. of ponds:	1 pond/s
Includes irregular ponds?	No
Pond 1	
- total volume:	7065 cubic metres
- pumpable volume:	5056 cubic metres
- surface area:	2800 square metres
- width:	40.0 metres
- length:	70.0 metres
- batter:	3.0:1
- total height:	4.6 metres
- pumped?	Yes
Tank/s present?	No
Emergency storage period:	2 days

Solids Separation

Solids separator/s present?	No

Outputs

Maximum required storage pond volume:	30634 cubic metres
90 % probability storage pond volume:	21618 cubic metres
During the period from:	01 July 1976
To:	30 June 2013


Required Annual Storage Volumes
Volume (cubic m...
35000
30000
25000
20000
15000
10000
5000
0
30634
Your total pumpable pond volume is 5056 cubic metres.
1976
1986
1996
2006
Year

Dairy Effluent Storage Calculator
Summary Report

Regional authority: Horizons Regional Council
Authorised agent: Albert van Oostrom & Associates
Client: Crusader Meats NZ Ltd
Program version: 1.46
Report date: Friday, 26 August 2016
General description:

Scenario B: Proposed 1500 m³ daily irrigation volume.

Monthly average daily effluent volumes are those irrigated for the period 1/06/2015 to 31/05/2016. They reflect current production levels.

Climate

Rainfall site: Taumarunui
Mean annual rainfall: 1513 mm/year

Effluent Block

Area of low risk soil: 149.9 hectares
Minimum area of high risk soil: 0.0 hectares
Surplus area of high risk soil: 0.0 hectares

Wash Water

Yard wash:

- Milking season starts: 01 August
- Milking season ends: 31 July

Average daily

Month	Number of Cows	Hours in Yard	Wash Volume (cubic metres)
January	0	0.0	534.0
February	0	0.0	504.0
March	0	0.0	438.0
April	0	0.0	529.0
May	0	0.0	456.0
June	0	0.0	557.0
July	0	0.0	598.0
August	0	0.0	452.0
September	0	0.0	439.0
October	0	0.0	452.0
November	0	0.0	235.0
December	0	0.0	458.0

Irrigation

Winter-spring depth: 44 mm
Spring-autumn depth: 45 mm
Winter-spring volume: 1500 cubic metres
Spring-autumn volume: 1500 cubic metres
Irrigate all year? Yes

Catchments

Yard Area:	1200 square metres
Diverted?	No
Shed Roof Area:	5000 square metres
Diverted?	Yes
Feedpad Area:	0 square metres
Covered?	No
Diverted?	No
Animal Shelter Area:	0 square metres
Covered?	No
Diverted?	No
Other Areas:	0 square metres

Storage

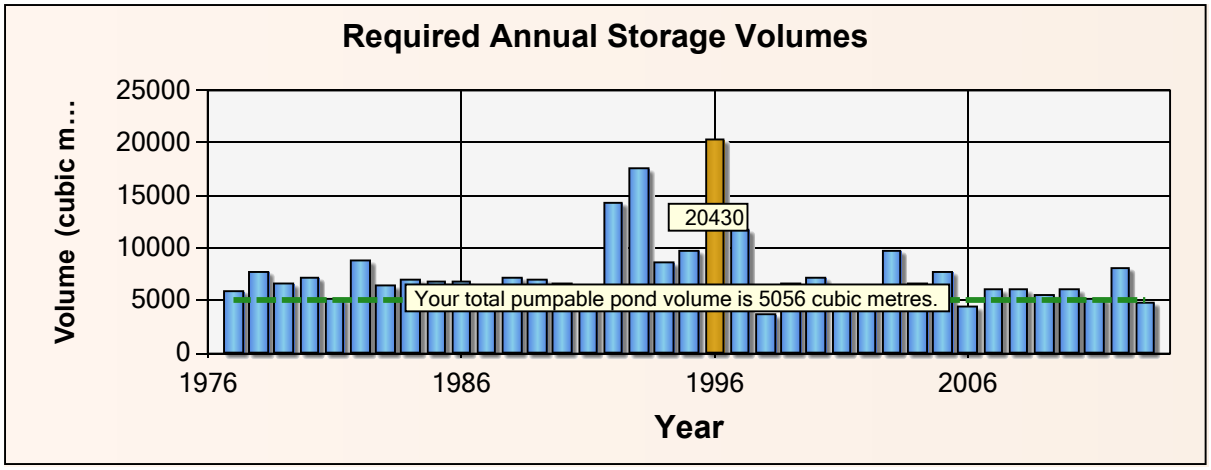
Pond/s present?	Yes
No. of ponds:	1 pond/s
Includes irregular ponds?	No
Pond 1	
- total volume:	7065 cubic metres
- pumpable volume:	5056 cubic metres
- surface area:	2800 square metres
- width:	40.0 metres
- length:	70.0 metres
- batter:	3.0:1
- total height:	4.6 metres
- pumped?	Yes
Tank/s present?	No
Emergency storage period:	2 days

Solids Separation

Solids separator/s present?	No

Outputs

Maximum required storage pond volume:	20430 cubic metres
90 % probability storage pond volume:	12108 cubic metres
During the period from:	01 July 1976
To:	30 June 2013


Required Annual Storage Volumes
Volume (cubic m...
25000
20000
15000
10000
5000
0
1976
1986
1996
2006
Year
20430
Your total pumpable pond volume is 5056 cubic metres.