Uruti Composting Facility

Irrigation Block Nitrogen Balance Analysis

Prepared for

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Contents

1.0 Executive Summary

In September 2019 AECOM New Zealand Ltd prepared a report intitled "Uruti Composting Facility: Nitrogen Balance" for Remediation New Zealand (RNZ), in response to a request for further information in relation to consent renewal applications for the RNZ Uruti Composting Facility. The report used OVERSEER® to model nitrogen flows within the farm and compost operation. The report modelled a number of scenarios and made recommendations to reduce Nitrogen losses.

As a consequence of the report a number of changes to the operation of the compost process and the irrigation system were made by RNZ and this report reviews and models these changes. OVERSEER® and monitoring data were used to identify sources of nitrogen entering the system, leaving the system and quantify the effect on the receiving environment.

Using the OVERSEER® base file, two scenarios were modelled using different volumes of compost applied to the Irrigation Area.

The report makes a number of conclusions including:

- The amount of nitrogen generated from the composting operation can be reduced using good management practices;
- Harvesting pasture and removing it off site as baleage removes significant amounts of nitrogen from the system;
- A review of six analytes sampled in monitoring bores showed that the ground water leaving the Uruti catchment is generally in better condition than groundwater entering the composting site;
- Nitrogen leached from the root zone on a whole farm basis varies only slightly between scenarios due to the large farm area and the significant area that is fallow/in bush and scrub.
- From the irrigation area only, nitrogen losses from the root zone ranged from 77 kg N/ha/yr under the scenario with no compost applied to 257 kg N/ha/yr when 2000 m^3 compost/year is applied to the irrigation areas.
- Monitoring of the groundwater leaving the Uruti catchment showed that the Nitrite-Nitrogen levels of groundwater is below the New Zealand Drinking Water Standards (2008) Maximum Acceptable Value (MAV), even under previous management conditions (i.e. with none of the measures to reduce nitrigen losses in place).
- The September 2019 AECOM report indicated that losses under this 2019 management scneario were 3,563 kg N/year. Compared to the 2019 scenario modelled by AECOM (which has led to the management changes and mitigation measures that are now presented in this report), N losses are significantly reduced.

2.0 Introduction

2.1 Background

Kay Consulting Ltd has been engaged by RNZ to review the AECOM OVERSEER® nitrogen modelling report dated 13 September 2019 and update the OVERSEER® file to take into account the changes in the site infrastructure and management since the report was published. Different options for application of compost have also been considered. The AECOM OVERSEER® budget for the current and projected 2019 year indicated total N losses from the irrigation areas were 3563 kg N/yr, or 992 kg N/ha/yr. (Based on 2019 irrigation areas).

2.2 Project Scope

The scope of this report is confined to;

- The areas on the Uruti site which include the Irrigation pond and the two irrigation areas, and;
- The compost located on Pads 1 & 3 which is suitable to be spread onto the irrigations areas as a soil conditioner and fertiliser.

The report is prepared on the basis that drilling mud deliveries cease on 31 December 2020. The OVERSEER® file will use the status quo year of 2022.

2.3 Qualification of the Author

- B Ari Sc specialising in Agricultural Engineering
- Certificate in Advanced Sustainable Nutrient Management
- CNMA – Certified Nutrient Management Adviser

3.0 Description of the site activity

3.1 Site map

FIGURE 1: SITE OVERVIEW & IRRIGATION BLOCK LOCATIONS

TABLE 1: IRRIGATION AREA BREAKDOWN

Block	Area (ha)
Upper Irrigation	5.12
Lower Irrigation	8.05
Total area	13.17

3.2 Description of the site activity

The RNZ Pads 1 & 3 at Uruti processes organic waste and green waste.

The organic wastes are deposited into the receiving pad and the site operator then incorporates/mixes the organic waste with green waste and sawdust and incorporates the mixed material into the compost pile.

Leachate and stormwater runoff from the compost piles are collected and move through a series of the settlement ponds and then it is stored in the final pond.

3.3 Composting operation

The operation of the composting operation is controlled by the Site Practices Plan which specifies the methods used to generate and manage the compost windrows. A correctly constructed compost windrow will form a thatch that will shed stormwater. A well-managed compost windrow will create minimal leachate.

3.4 Aeration of pond liquid

The storage pond is aerated using the irrigation pump to recycle pond liquid through an aerator. The aeration of the pond liquid causes the reduction of ammonium (NH_4) to ammonia (NH_3) and the subsequent loss of ammonia gas to the atmosphere (volatisation process). Refer to Appendix 2 Nitrogen cycle.

3.5 Irrigation of pond liquid

When climatic conditions and soil conditions are suitable the irrigation pond liquid is pumped through a buried mainline to the irrigator which discharges the liquid onto land.

The operation of the irrigation system is controlled by the Leachate and Stormwater Management Plan – refer to Appendix 1.

3.6 Cut and carry of the harvested pasture

Pasture from the irrigation block is harvested between September and April and transported off site or used in the composting process. When the pasture has reached a suitable height, it is cut and allowed to wilt before being processed into baleage. Each bale weighs approximately 800 kg and would contain approximately 320 kg of dry matter.

For the purposes of this report (and associated OVERSEER® model) it has been predicted that 4 cuts of hay/baleage will be taken each year in the months of October, November, January and April. It is predicted that 616 bales will be made and removed off site.

The removal of harvested pasture from the irrigation areas will remove significant amounts of nutrients from the soil. While the aim of the cut and carry operation is to remove excess nitrogen, this practice will also remove other nutrients essential for pasture health and growth. Regular soil tests will identify any essential nutrient deficits, and these should be replaced in a customised fertiliser dressing. Nitrogen fertiliser will not be required.

4.0 Nutrient Balance of status quo nutrient budget

4.1 OverseerFM Software Overview

OVERSEER® is a software programme used to model nutrient cycling on-farm. OVERSEER® takes nutrients that are present or introduced to the farm, models how they are used by plants and animals on the farm and estimates how they leave the farm and in what form.

OVERSEER® can be used to model different farm management practices in an attempt optimise the efficient use of nutrients and reduce their losses from the farm.

It was determined that OVERSEER® is an appropriate tool to provide an estimate of nitrogen loading and losses across the irrigation areas.

4.2 Nutrients entering and leaving the irrigation Area

OVERSEER® calculates the addition and removal of 7 nutrients being nitrogen, phosphorus, potassium, sulphur, calcium, magnesium and sodium. This report focuses on the nitrogen loading and losses from the site.

Nitrogen enters the Irrigation Area through the irrigated liquid, rainfall and clover fixation.

Nitrogen leaves the Irrigation Area by being leached below the root zone, by volatilisation and denitrification to the atmosphere and in the harvested pasture in the form of baleage.

Nitrogen moves between the organic and inorganic pools within the soil. Generally, nitrogen in the organic form is held in the soil and is not available for plant uptake and does not leach from the root zone. Nitrogen in the Inorganic form are plant available and in certain circumstances can leach through the soil*.

**Refer to Appendix 2 - Nitrogen cycle.*

4.3 Nitrogen entering the irrigation Area

Nitrogen concentrations in the irrigation pond have been monitored on a regular basis since 2014. The major form of nitrogen recorded in the pond is Ammoniacal nitrogen (NH_4) with levels ranging between 17.6 to 590 g/m^3 with the average concentration being 226.7 g/m^3.

For the purposes of this report the Ammoniacal nitrogen sampling results between August 2016 to March 2020 were used to calculate the Nitrogen applied as fertiliser to the irrigation blocks. The Nitrogen application rate, kg N/ha, was calculated by multiplying the volume pumped by the Ammoniacal nitrogen concentration and divided by the total irrigation area. The sampling data was grouped into seasons ie Summer, Autumn, Winter and Spring and the seasonal results were averaged to calculate a seasonal Nitrogen concentration average.

	Summer	Autumn	Winter	Spring
Nitrogen concentration g/m3	341.8	305.8	159.8	126.0

		Vol pumped	N concentration	Total N	Application rate
		m3	g/m3	Kg	Kg N/ha
Jan	Summer	805	341.8	275.2	20.9
Feb	Summer	1720	341.8	588.0	44.7
Mar	Autumn	2090	305.8	639.1	48.6
Apr	Autumn	1595	305.8	487.8	37.1
May	Winter	2610	159.8	416.9	31.7
Jun	Winter	1570	159.8	250.8	19.1
Jul	Winter	1755	159.8	280.4	21.3
Aug	Winter	2620	159.8	418.5	31.8
Sep	Spring	2020	126.0	254.5	19.3
Oct	Spring	1475	126.0	185.9	14.1
Nov	Summer	1160	341.8	396.5	30.1
Dec	Summer	1030	341.8	352.1	26.8

The calculated application rate was entered into Overseer as fertiliser

Nitrogen also enters the Irrigation Area with rain and clover fixation.

4.4 Total volume of irrigation liquid irrigated onto the Irrigation Blocks

The irrigation liquid is pumped from the pond to the irrigator through a buried pipeline. The pumping flow rate was measured by BTW company in 2015 as 30 m^3/hr[1].

[1] *Uruti Composting Facility Management Plan, BTW Company Limited, 2015. (provided as Appendix J of the Application for Consent Renewal)*

The pumping hours are recorded in the irrigation log and for the purposes of this report the average pumping hours for years 2017 to 2019 were used.

The irrigation log recording the pumping hours and the calculated volume pumped in shown in Table 2 below:

Table 2: Irrigation log for years 2017 to 2019

	2017 Hours	2018 Hours	2019 Hours	2020 Hours	Average Hours	Pump rate m3/hr	Volume pumped m3
Jan	28.5	28.5	23.5		26.8	30	805
Feb	42	99	31		57.3	30	1,720
Mar	77.5	77.5	54		69.7	30	2,090
Apr	50	50	59.5		53.2	30	1,595
May	153	53	55		87.0	30	2,610
Jun	60	60	37		52.3	30	1,570
Jul	41	41	93.5		58.5	30	1,755
Aug	92.5	92.5	77		87.3	30	2,620
Sep	54.5	54.5	93		67.3	30	2,020
Oct	34.5	34.5	78.5		49.2	30	1,475
Nov	45	45	26		38.7	30	1,160
Dec	33	36.0	34		34.3	30	1,030
Total	711.5	671.5	662		681.7	30	20,450

These figures are considered to be representative of irrigation volumes that would be expected to occur in the future and have been used to inform the rate of application of the irrigation fluid in OVERSEER®.

4.5 Total Kg of Nitrogen irrigated onto the Irrigation Blocks

The total kgs of nitrogen applied to the irrigation blocks is calculated by multiplying the pond nitrogen concentration (g/m^3) x irrigation volume (m^3).

Based on the irrigation volumes in Table 2, the total kg of nitrogen that would be applied using different nitrogen concentrations in the irrigation fluid is shown in table 4 below. This shows the effect of a change in nitrogen concentration on the overall total kgs of N applied.

TABLE 3:TOTAL KG OF NITROGEN APPLIED USING DIFFERENT N CONCENTRATIONS BASED ON IRRIGATION VOLUMES IN TABLE 2.

		N concentration of irrigation fluid g/m3										
		100	150	200	225	250	275	300	325	350	375	400
Kgs of Nirogen applied in the irrigated liquid	Jan	81	121	161	181	201	221	242	262	282	302	322
	Feb	172	258	344	387	430	473	516	559	602	645	688
	Mar	209	314	418	470	523	575	627	679	732	784	836
	Apr	160	239	319	359	399	439	479	518	558	598	638
	May	261	392	522	587	653	718	783	848	914	979	1,044
	Jun	157	236	314	353	393	432	471	510	550	589	628
	Jul	176	263	351	395	439	483	527	570	614	658	702
	Aug	262	393	524	590	655	721	786	852	917	983	1,048
	Sep	202	303	404	455	505	556	606	657	707	758	808
	Oct	148	221	295	332	369	406	443	479	516	553	590
	Nov	116	174	232	261	290	319	348	377	406	435	464
	Dec	103	155	206	232	258	283	309	335	361	386	412
Totals kg N/yr		2,045	3,068	4,090	4,601	5,113	5,624	6,135	6,646	7,158	7,669	8,180

The scenario modelled in OVERSEER® (concentration of 225 g/m^3) results in 4,601 kg N/year in total being applied to the 13.17 ha irrigation area. A reduction in concentration from 225 g/m^3 to 200 g/m^3 (25 g/m^3) would reduce total nitrogen application by 511 kg N/year.

4.6 Kg of Nitrogen applied per ha

The nitrogen application rates in kg/ha was calculated using the nitrogen concentration table above and is shown in Table 4 below:

TABLE 4: NITROGEN APPLICATION RATES KG/HA/YR USING DIFFERENT N CONCENTRATIONS

	Area ha	13.16									
g/m3	100.00	150.00	200.00	225.00	250.00	275.00	300.00	325.00	350.00	375.00	400.00
Jan	6	9	12	14	15	17	18	20	21	23	24
Feb	13	20	26	29	33	36	39	42	46	49	52
Mar	16	24	32	36	40	44	48	52	56	60	52
Apr	12	18	24	27	30	33	36	39	42	45	48
May	20	30	40	45	50	55	59	64	69	74	79
Jun	12	18	24	27	30	33	36	39	42	45	48
Jul	13	20	27	30	33	37	40	43	47	50	53
Aug	20	30	40	45	50	55	60	65	70	75	80
Sep	15	23	31	35	38	42	46	50	54	58	61
Oct	11	17	22	25	28	31	34	36	39	42	45
Nov	9	13	18	20	22	24	26	29	31	33	35
Dec	8	12	16	18	20	22	23	25	27	29	31
KgN/ha/yr	155.4	233.1	310.8	349.6	388.5	427.3	466.2	505.0	543.9	582.7	610.3

The scenario modelled (concentration of 225 g/m^3) results in application of 349.6 kg N/ha/year. A reduction in concentration of 25 g/m^3 would reduce nitrogen application by 38.8 kg N/ha/year.

4.7 Overseer data input

Data was entered into the OVERSEER® model as outlined in Table 5 show below:

TABLE 5: OVERSEER DATA INPUT

Overseer Section	Scenario Modelled (Scenarios 1 and 2 are identical except for compost application rate)
Blocks	Blocks were drawn from maps created from a drone survey carried out 22 May 2020 and notes from site visits. Upper Irrigation Block – 5.12 ha Lower Irrigation Block – 8.04 ha
Climate	Overseer defaults according to latitude and longitude
Soil *Farm Soils*	No S-Map data for the area was available (Overseer's default source for soil classification). Soil data was input as: order = Brown, soil group = sedimentary (as per BTW, 2015, section 2.3.1). Model sensitivity to soil drainage class and topsoil texture was investigated. Upper irrigation Block: Soil drainage class = poor. Topsoil texture = silt loam. Stoney = no. No root barrier depth assumed. Drainage impeded layer assumed at 20cm (BTW, 2015). Upper irrigation Block: Soil drainage class = moderately well. Topsoil texture = silt loam. Stoney = no. No root barrier depth assumed. Drainage impeded layer assumed 100cm (BTW, 2015). Soils test data from 12-04-2019 (RNZ, 2019)
Soil tests	
Drainage	No drainage method assumed for the irrigation areas.
Pasture/crops	Irrigation areas assumed; 'flat topography', 'grass only', cultivated in the last 5 years, no animals present.
Animals	No animals present.
Structure/effluent	No dairy effluent system.
Supplements	Baleage harvested from the irrigation areas. All distributed offsite. Bale sizing assumed round (15 bale equivalents), 800 kg wet wt. 320 kg DM/bale. Harvested assumed in October (187 bales), November (173), January (115) and April (86).
Fertiliser	Irrigation pond nutrients modelled as 'custom soluble fertiliser'. Custom Soluble Fertiliser details: - N = 225g/m^3 - Application rate determined in accordance with Table 4

	Compost; modelled as 'custom organic fertiliser', 'compost/mulches', 60% dry matter, 0.61% N, 0.19% P, 0.27% K– data from Uruti compost analysis (Hill Laboratories compost testing results 16 January 2020).	
Compost application	Scenario 1 – 1, 000 m3 (500 tonnes) compost applied per year ('2022+compost 1000')	Scenario 2 – 2,000 m3 compost applied per year (1000 tonnes) ('2022+compost 2000')
	1,000 m^3 of compost converts to 500 tonnes which when applied in three applications to 12 ha at a rate of 12.7 tonne/ha.	2,000 m^3 of compost converts to 1,000 tonnes which when applied in three applications to 12 ha at a rate of 25.3 tonne/ha.
GHG	Defaults not overridden.	

4.8 Total Nitrogen entering the Irrigation Area in irrigation fluid

The total amount of nitrogen entering the system as a result of irrigation fluid application is calculated by OVERSEER® and shown in Table 6 below:

TABLE 6: NITROGEN ENTERING THE IRRIGATION AREA

Nitrogen entering the system –		Upper Irrigation Block	Lower Irrigation Block
In irrigation fluid	Kg/ha/yr	346	346
In rainfall and clover fixation	Kg/ha/yr	29	27
Total		375	378

4.9 Total Nitrogen leaving the Irrigation area from irrigation fluid

The total amount of nitrogen removed from the Irrigation Area calculated by OVERSEER® is shown in Table 7 below:

TABLE 7: NITROGEN REMOVED FROM THE IRRIGATION AREA

Nitrogen removed from the system		Upper Irrigation Block	Lower Irrigation Block
Leached from the root zone	Kg/ha/yr	79	76
To atmosphere	Kg/ha/yr	33	33
As baleage	Kg/ha/yr	265	265
Added to the organic Nitrogen pool	Kg/ha/yr	-2	-1
Total		375	373

4.10 Nitrogen leaving the whole farm

OVERSEER® calculates the amount of Nitrogen leached from the root zone from the Irrigation Area and it is shown in Table 8below:

TABLE 8: TOTAL NITROGEN LEACHED FROM THE ROOT ZONE FROM THE IRRIGATION AREA CALCULATED BY OVERSEER.

Total Nitrogen leached from the Irrigation Area		Kg/yr	Kg/ha/yr
Leached from the Upper Irrigation Area	5.12 ha	404	79
Leached from the Lower Irrigation Area	8.05ha	606	76
Total Nitrogen leached from the root zone		1,010	77

Overseer calculates that a total of 1,010 kg N/yr is leached from the root zone of the Irrigation Area under this scenario. The irrigation blocks are one component of total nitrogen loss from the farm. Nitrogen loss represented on a whole farm basis, modelling the remainder of the land as unproductive/ungrazed pasture or trees and scrub is shown in Table 9 below:

TABLE 9: TOTAL NITROGEN LEACHED FROM THE IRRIGATION AREA ON A WHOLE FARM BASIS.

Total Nitrogen leached from the Irrigation Area on a whole farm basis		
Total Nitrogen leached from the root zone	Kg	2,273
Whole farm area	Ha	641
Nitrogen leached on a whole farm basis	Kg N/ha/yr	4

4.11 Fate of Nitrogen leached from the root zone

Nitrogen can be attenuated (reduced) by different biogeochemical processes on its journey after leaching from the root zone till it reaches the sampling point at the catchment outlet.

In low oxygen subsurface environments, nitrate can be reduced and emitted as a nitrogen gas, via a biogeochemical process of denitrification in the subsurface environment. As a result, nitrogen losses are said to be attenuated before entering and effecting the receiving water body.

Groundwater leaving the Uruti site catchment is monitored at the monitoring well GND 3007 sited near State Highway 3. Monitoring of this well started in April 2018 and the sampling results are shown in Table 10 below:

TABLE 10: MONITORING RESULTS OF SAMPLING THE MONITORING WELL GND 3007 SITED NEAR STATE HIGHWAY 3 RECORDS THE GROUNDWATER LEAVING THE URUTI CATCHMENT

New monitoring bore GND 3007 Beside SHW 3		Chloride	Conductivity	NH4 Ammoniacal nitrogen	NNN Nitrite/ Nitrate nitrogen	PH	LEVEL	Temperature	NH3 Un-ionised ammonia	Total Disolved Solids
	Tier One	0 - 1,000	< 350							
	Tier Two	1,00 - 2,000	350 - 700							
	Tier Three	> 2,000	> 700							
Site	Collected	g/m3	mS/m@20C	g/m3 N	g/m3 N	pH	m	Deg.C	g/m3	g/m3
GND3007	26/04/18	20.6	32.1	2.98	0.03	6.2	2.702	17.1	0.00182	248.4
	28/08/18	37	23.7			6		14.8		156
	30/07/19	19.4	14.4	0.135	<0.002	5.9		13	0.000032	90
	31/10/19	27	17.7	0.023	<0.002	5.6		14.4	<0.000010	112

For drinking water, the New Zealand Drinking Water Standards (2008) set a Maximum Acceptable Value (MAV) of 50 mg/l for nitrate, which is the equivalent to 11.3 g/m^3 nitrate-nitrogen.

The sampling results for monitoring bore GND 3007 show the levels of nitrite/nitrate nitrogen ranged between 0.003 g/m^3 and less than 0.002 g/m^3

A monitoring bore GND 2188 is located upstream of the upper Irrigation Area and monitors the groundwater before it enters the Irrigation and composting areas. Monitoring of this well started in February 2011 and the sampling results are shown in Table 11 below:

TABLE 11: MONITORING RESULTS OF SAMPLING THE MONITORING BORE GND 2011 SITED ABOVE THE UPPER IRRIGATION AREA RECORDS THE GROUNDWATER ENTERING THE URUTI COMPOSTING AREA.

Control monitoring bore GND 2188		Chloride	Conductivity	NH4 Ammoniacal nitrogen	NNN Nitrite/ Nitrate nitrogen	PH	LEVEL	Temperature	NH3 Un-ionised ammonia	Total Disolved Solids
	Tier One	0 - 1,000	< 350							
	Tier Two	1,000 - 2,000	350 - 700							
	Tier Three	> 2,000	> 700							
Site	Collected	g/m3	mS/m@20C	g/m3 N	g/m3 N	pH	m	Deg.C	g/m3	g/m3
GND2188	4/02/11	50.4	64.4	0.106	2	7.1	0.89	18.3	0.00056	498.3
GND2188	11/02/11	53.1	64.1			7.1	0.88	18.1		495.9
GND2188	19/08/11	40.2	52.7	1.14	0.01	7.3	0.76	12.9	0.0064	407.7
GND2188	26/04/12	63	70.2	1.16	0.02	6.9	1.4	16.4	0.00337	543.1
GND2188	21/11/12	58.4	65.2	0.91	0.34	6.8	1.27	15.4	0.00195	504.5
GND2188	14/06/13	71.3	46.7	0.023	7.76	6.3	0.83	14.5	0.00001	361.3
GND2188	14/01/14	63.5	52.5	0.325	1.29	6.6	1	17.7	0.00052	406.2
GND2188	15/05/14	90.5	57	0.048	8.52	6.2		16.2	0.00003	441
GND2188	20/06/14	75.2	47.3	0.64	1.87	6.6		13.7	0.00076	366
GND2188	21/01/15	70.2	66.3	0.512	<0.01	6.7		15.9	0.0009	513
GND2188	30/04/15	92.2	58.8	0.171	<0.01	6.4	0.703	15.7	0.00015	454.9
GND2188	16/03/16	70.4	71.2	0.676	<0.01	6.8	1.43	18.1	0.00177	550.9
GND2188	8/06/16	159	66.7	0.03	7.47	5.9	0.675	14.2	0.00001	516.1
GND2188	3/08/16	238	95.6	0.12	1.64	5.9	0.28	13	0.00003	739.7
GND2188	14/12/16	333	132	0.182	0.02	5.8	0.998	14.5	0.00004	1021.3
GND2188	17/08/17	102	65.5	0.253	<0.01	5.9	0.33	12.6	0.00006	506.8
GND2188	28/02/18	89.9	76.7	1.91	<0.01	6.6	0.954	18.2	0.00318	593.4
GND2188	26/04/18	71.9	51.5	0.006	7.46	5.4	0.671	17	<0.00001	398.5
GND2189	28/08/18	82	76.6			6.6		13.7		480
GND2190	22/02/19	81	77.5	1.15	0.4	6.9		17.7	0.0036	470
GND2191	30/07/19	111	74.4	2.1	0.009	6.7		14.2	0.0031	470
Average		98.4	68.2	0.6	2.8	6.5	0.9	15.6	0.00147	511.4

Results of monitoring bores sampling of groundwater entering and leaving the site is summarised in Table 12 shown below. Six analytes were compared, and the results showed that 5 analytes improved (decreased) and one analyte worsened (increased) in the groundwater leaving the catchment when compared with the groundwater entering the composting site.

TABLE 12: COMPARING THE MONITORING RESULTS OF THE GROUNDWATER ENTERING AND LEAVING THE URUTI COMPOSTING SITE USING AVERAGED SAMPLING RESULTS FROM TABLE 10 AND TABLE 11.

		Chloride	Conductivity	Ammoniacal Nitrogen NH_4	NNN Nitrite/Nitrate Nitrogen	Un-ionised ammonia NH_3	Total Disolved Solids
		g/m^3	mS/m@20C	g/m^3 N	g/m^3 N	g/m^3	g/m^3
Groundwater entering the site	GND2018	98.39	68.23	0.60	2.77	0.00147	511.36
Groundwater leaving the catchment	GND3007	26.00	21.98	1.05	0.03	0.00093	151.60
Difference		-72.39	-46.26	0.44	-2.74	-0.00054	-359.76
% Difference		-74%	-68%	73%	-99%	-37%	-70%

Sampling of Ammoniacal Nitrogen in a bore representative of groundwater leaving the catchment has occurred on three occasions. The first sampling event occurred in April 2018 shortly after the bore was constructed. The first sampling event (April 2018) showed a high level of Ammoniacal Nitrogen in ground water and the two subsequent samplings (July and October 2019) showed a lower result. Further sampling of this bore is required to establish a representative trend.

The potential for groundwater/surface water connectivity has been considered. Analysis of surface water monitoring results is more complex given the other potential inputs to the system, however indicates that the levels in surface water are generally compliant, and that spikes in NH_4 in surface water leaving the site are linked to specific management events/incidents, as opposed to ongoing irrigation activities. This is discussed in section 5 of the AEE for the renewal of consents at the site and other management changes will address these issues.

It is noted that the monitoring results discussed reflect historic management practices at the site, while the OVERSEER® modelling projects forwards and is based on the activities on the site in 2022. It is therefore not appropriate to directly correlate the OVERSEER® predictions in this report with the historic monitoring data. The purpose of including this information is to show that even under current practices, the groundwater quality leaving the site is acceptable.

Significant changes have been, and will continue to be implemented to mitigate effects (these mitigation measures are also detailed in the AEE for renewal of consents at the site) and are anticipated to further improve discharge quality and further reduce potential and actual effects on the environment.

5.0 Compost Applications

5.1 Background

Mature compost from pads 1 and 3 is applied to the irrigation areas as a soil conditioner.

Two scenarios are modelled in Overseer to show the effect of the compost applications at different application rates.

5.2 Compost Application

It is proposed to apply compost to the 13.17 ha irrigation area in 3 equal applications in November, January and March of each year. The report assumes the compost has a bulk density of 500 kg/m^3.

Scenario 1

1,000 m^3 of compost converts to 500 tonnes which when applied to 13.17 ha at a rate of 12.7 tonne/ha.

Scenario 2

2,000 m^3 of compost converts to 1,000 tonnes which when applied to 13.17 ha at a rate of 25.3 tonne/ha.

5.3 Compost Nutrient Analysis

A compost nutrient analysis is contained in a Hill Laboratories analysis dated 16 January 2020. The nutrient analysis is shown in Table 13 below:

TABLE 13: NUTRIENT ANALYSIS OF COMPOST DATED 16 JANUARY 2020 ON A WET WEIGHT BASIS

	DM	Nitrogen	Phosphorus	Potassium	Sulphur	Calcium	Magnesium	Sodium
	%	%	%	%	%	%	%	%
Dry wgt		0.61	0.19	0.27	0	0	0	0
Wet wgt	60	0.336	0.114	0.162	0	0	0	0

5.4 Scenario 1 - Nutrient Budget Nitrogen analysis of compost application - (1000 m^3)

The compost application rate shown in 5.2, Scenario 1 and the nutrient analysis listed in table 11 were entered into OVERSEER scenario 2022 + compost c. The total nutrients entering and leaving the Irrigation Area from the irrigation fluid and the compost was calculated by OVERSEER and the amounts of Nitrogen entering and leaving the Irrigation Area are shown in tables 15, 16, 17 and 18 below.

5.5 Total Nitrogen entering the Irrigation Area with the addition of compost applications

The total amount of nitrogen entering the Irrigation Area calculated by OVERSEER® is shown in Table 14 below:

TABLE 14: NITROGEN ENTERING THE IRRIGATION AREA WITH THE ADDITION OF COMPOST APPLICATIONS - SCENARIO 1 (1000 M^3)

Nitrogen entering the Irrigation Areas		Upper Irrigation Block	Lower Irrigation Block	
In irrigation fluid	Kg/ha/yr	346	346	
In compost	Kg/ha/yr	114	114	
In rainfall and clover fixation	Kg/ha/yr	11	23	
Total		471	483	

5.6 Total Nitrogen leaving the Irrigation Area with the addition of compost application

The total amount of nitrogen removed from the Irrigation Area calculated by OVERSEER® is shown in Table 15 below:

TABLE 15: NITROGEN REMOVED FROM THE IRRIGATION AREA WITH THE ADDITION OF COMPOST APPLICATIONS - SCENARIO 1 (1000 M^3)

Nitrogen removed from the Irrigation Areas		Upper Irrigation Block	Lower Irrigation Block	
Leached from the root zone	Kg/ha/yr	129	177	
To atmosphere	Kg/ha/yr	46	30	
As baleage	Kg/ha/yr	274	267	
Added to the organic Nitrogen pool	Kg/ha/yr	22	9	
Total		471	483	

5.7 Nitrogen leaving the whole farm with the addition of compost applications

OVERSEER® calculates the amount of Nitrogen leached from the root zone from the Irrigation Area and it is shown in Table 16 below:

TABLE 16: TOTAL NITROGEN LEACHED FROM THE ROOT ZONE FROM THE IRRIGATION AREA WITH THE ADDITION OF COMPOST APPLICATIONS AS CALCULATED BY OVERSEER – SCENARIO 1 (1000 M^3)

Total Nitrogen leached from the Irrigation Area		Kg/yr	Kg/ha/yr
Leached from the Upper Irrigation Area	5.12 ha	658	129
Leached from the Lower Irrigation Area	8.05 ha	1,435	178
Total Nitrogen leached from the root zone		2,093	159

Overseer calculates that 2,093 kg N/yr is leached from the root zone of the Irrigation Area when irrigation fluid plus 1000m^3/ha/year compost is applied.

The irrigation blocks are one component of total nitrogen loss from the farm. Nitrogen loss represented on a whole farm basis, modelling the remainder of the land as unproductive/ungrazed pasture or trees and scrub is shown in Table 17 below:

TABLE 17: TOTAL NITROGEN LEACHED ON A WHOLE FARM BASIS - SCENARIO 1 (1000 M^3)

Total Nitrogen leached from the Irrigation Area on a whole farm basis		Scenario 1 (1,000 m^3 compost)
Total Nitrogen leached from the root zone	Kg/yr	3,356
Whole farm area	Ha	641
Nitrogen leached on a whole farm basis	Kg N/ha/yr	5

OVERSEER® calculates that the compost applications added 114 kg N/ha/yr to the irrigation Area and the total nitrogen leached from the Irrigation Area increased by 823 kg N/yr from 1,270 to 2,093 kg N.

When modelled on a whole farm basis, nitrogen leached over the whole farm increased from 4 to 5 kg N/ha/yr as a result of the application of 1000m3/compost.

5.8 Scenario 2 - Nutrient Budget Nitrogen analysis of compost application - (2000 m^3)

The compost application rate shown in 5.2, Scenario 2 and the nutrient analysis listed in table 11 were entered into OVERSEER scenario 2022 + compost b. The total nutrients entering and leaving the Irrigation Area from the irrigation fluid and the compost was calculated by OVERSEER and the amounts of Nitrogen entering and leaving the Irrigation Area are shown in tables 16, 17, 18 and 19 below.

5.9 Total Nitrogen entering the Irrigation Area with the addition of compost applications

The total amount of nitrogen entering the Irrigation Area calculated by OVERSEER® is shown in Table 18 below:

TABLE 18: NITROGEN ENTERING THE IRRIGATION AREAS WITH THE ADDITION OF COMPOST APPLICATIONS - SCENARIO 2 (2000 M^3)

Nitrogen entering the system		Upper Irrigation Block	Lower Irrigation Block	
In irrigation fluid	Kg/ha/yr	346	346	
In compost	Kg/ha/yr	227	227	
In rainfall and clover fixation	Kg/ha/yr	4	16	
Total		577	589	

5.10 Total Nitrogen leaving the Irrigation Area with the addition of compost applications

The total amount of nitrogen removed from the Irrigation Area calculated by OVERSEER® is shown in Table 19 below:

TABLE 19: NITROGEN REMOVED FROM THE IRRIGATION AREAS WITH THE ADDITION OF COMPOST APPLICATIONS - SCENARIO 2 (2000 M^3)

Nitrogen removed from the system		Upper Irrigation Block	Lower Irrigation Block	
Leached from the root zone	Kg/ha/yr	198	257	
To atmosphere	Kg/ha/yr	64	37	
As baleage	Kg/ha/yr	282	274	
Added to the organic Nitrogen pool	Kg/ha/yr	34	21	
Total		578	589	

5.11 Nitrogen leaving the whole farm with the addition of compost applications

OVERSEER® calculates the amount of Nitrogen leached from the root zone from the Irrigation Area and it is shown in Table 20 below:

TABLE 20: TOTAL NITROGEN LEACHED FROM THE ROOT ZONE FROM THE IRRIGATION AREA WITH THE ADDITION OF COMPOST APPLICATIONS AS CALCULATED BY OVERSEER – SCENARIO 2 (2000 M^3)

Total Nitrogen leached from the Irrigation Area		Kg/yr	Kg/ha/yr
Leached from the Upper Irrigation Area	5.12 ha	1,009	197
Leached from the Lower Irrigation Area	8.05 ha	2,079	258
Total Nitrogen leached from the root zone		3,088	235

Overseer calculates that 3088 kg N/yr is leached from the root zone of the Irrigation Area under this scenario. The impacts of this on nitrogen loss over the whole farm is shown in Table 21 below:

TABLE 21: TOTAL NITROGEN LEACHED FROM THE IRRIGATION AREA WITH THE ADDITION OF COMPOST APPLICATIONS ON A WHOLE FARM BASIS - SCENARIO 2 (2000 M^3)

Total Nitrogen leached from the Irrigation Area on a whole farm basis		Scenario 2 (2,000 m^3)
Total Nitrogen leached from the root zone	Kg/yr	4,352
Whole farm area	Ha	641
Nitrogen leached on a whole farm basis	Kg N/ha/yr	7

OVERSEER® calculates that the compost applications added 250 kg N/ha/yr to the irrigation Area and the total nitrogen leached from the Irrigation Area increased by 1,818 kg N/yr from 1,270 to 3,088 kg N.

Nitrogen leached on a whole farm increased due to the compost application (2000m^3) from 4 to 7 kg N/ha/yr.

6.0 Conclusion

- The amount of nitrogen applied to the irrigation areas is dependent on the nitrogen concentration in the Irrigation pond.
- The amount of nitrogen entering the irrigation pond is dependent on the type and volume of products received on the receiving and mixing pads.
- The amount of nitrogen entering the irrigation pond from rainfall runoff and leachate from the compost windrows is minimised by using good management practices in the construction and maintenance of the windrows.
- Operating the aerator at the Irrigation pond will remove nitrogen from the pond through volatisation.
- Significant amounts of nitrogen are removed from the soil in the irrigation areas with the cut and carry of harvested pasture.
- The cut and carry operation will also remove other nutrients essential for plant health and growth which will need to be replaced with a customised fertiliser dressing.
- An analysis of the total Nitrogen leached form the root zone of the Irrigation Area is shown in table 29 below:

TABLE 22: ANALYSIS OF NITROGEN LEACHED FROM THE ROOT ZONE – ALL SCENARIOS

		No compost	Scenario 1 (1,000 m^3)	Scenario 2 (2,000 m^3)	AECOM 2019 Scenario
Total Nitrogen leached from the root zone – irrigation area	Kg/yr	1,010	2093	3088	3563
Nitrogen leached from the root zone – irrigation area	Kg N/ha/yr	77	159	235	992
Nitrogen leached over whole farm	Kg N/ha/yr	4	5	7	11

- Under past site management practices, results of monitoring bores sampling shows groundwater leaving the site is below the NZ drinking water level guideline for Nitrate. The AECOM 2019 scenario shown in Table 22 would be indicative of the OVERSEER® modelled losses under the management practices occurring at the time of the recent samples.
- Compared to the 2019 scenario modelled by AECOM (which has led to the management changes and mitigation measures that are now presented in this report), N losses are significantly reduced.
- It is recommended that compost application be capped at 1000m^3/year at this stage, however over time the volume may be able to be increased as the nitrogen levels in irrigation water respond to the mitigation measures that have been put in place. The appropriateness of this could be demonstrated by modelling updated actual nitrogen concentrations in the irrigation water with increased compost application. The applicant may also investigate options for non-irrigation areas to apply compost to.

Appendix 1 – Leachate and Stormwater Management Plan

(Includes the Irrigation Standard Workplace Instruction)

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URUTI COMPOSTING & VERMICULTURE FACILITY

Leachate & Stormwater Management Plan

Document No:RU-650-0500-A

Revision No:1.5

Date: 5 June 2020

Version Control

Version	Date	Description	Prepared	Reviewed	Approved
V1.1	26-7-2018	Draft for review	C Kay		
V1.2	27-8-2018	Draft for review	C Kay		
V1.3	10-9-2018	Draft for review	C Kay		
V1.4	3-6-2020	Draft for review	C Kay		
V1.5	3-6-2020	Draft for review	C Kay		

Leachate & Stormwater Management Plan

Table of Content

0.0 Terms and Definitions

xxx yyy

1.0 Purpose of the Plan

The purpose of this document is to outline how the pond system that treats leachate generated from the compost pile and contaminated stormwater from pads 1 and 3 and the Truck Washdown area is managed.

2.0 General

The pad 1 and 3 pond system comprise of three separate ponds systems

- Pad 3 treatments ponds comprising:
    - Dewatering and settling pond
    - Silt collection pond
    - Skim pond
    - Settling ponds 1 & 2
    - Irrigation pond
- Duck pond
- Washdown settling pond

3.0 Resource consent conditions

Condition 14 Before 30 November 2015 the holder shall review and update the Uruti Composting Facility management Plan supplied in support of application 5838-2.2 and any changes shall be submitted for approval to the TRC. The plan shall be adhered to and reviewed on an annual basis (or as required) and any changes shall be submitted to the TRC. The plan shall include but not limited to;

a) Trigger limits for the three tier management system tiers set out in section 3.1 of the Uruti Composting Facility Management Plan
b) Monitoring frequencies of soil and groundwater in Tiers one, two, and three.
c) Remediation options for Tier three irrigation areas;
d) Riparian planting of irrigation areas;
e) Stormwater improvements at the site;
f) Water storage for dilution and remediation;
g) Soil and ground water analysis; and

Condition 20 The consent holder shall prepare a Pond Treatment System Management Plan which details management practices undertaken to maximise treatment capabilities of the system. The plan shall be submitted for approval to the TRC, within one month of the commencement date of this consent.

The Management Plan shall address but not necessarily be limited to, the following matters:

How the build-up of sediment and/or sludge will be managed within the entire system, how the level of build-up will be monitored including factors that will trigger management, and the frequency of undertaking the identified measures or procedures;

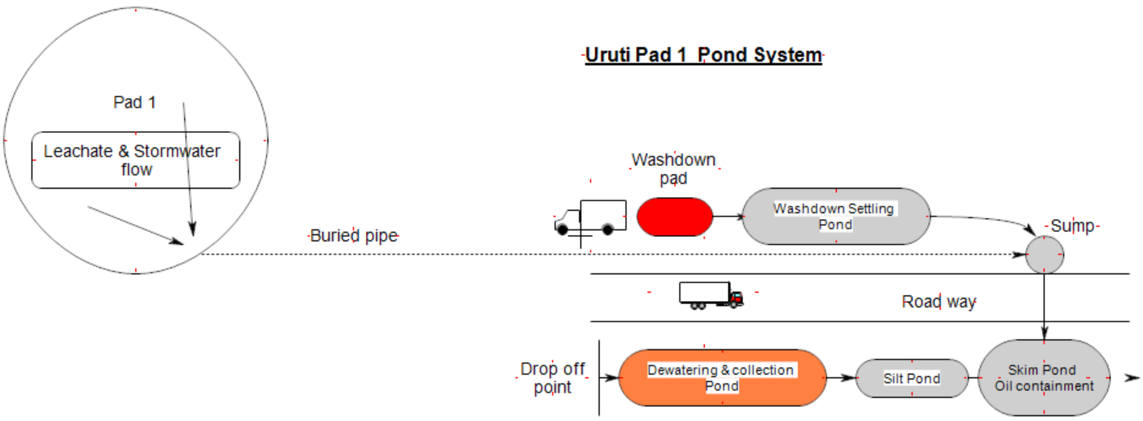
How overloading of the system will be prevented; and

How any offensive or objectionable odours at or beyond the boundary will be avoided in accordance with condition 13 of consent 5839-2

Condition 21 Operations on site shall be undertaken in accordance with the Pond Treatment System Management Plan, approved under condition 18 above, except in circumstances when the proposed Implementation Plan, approved under condition 9 of consent 5839-2, specifies otherwise.

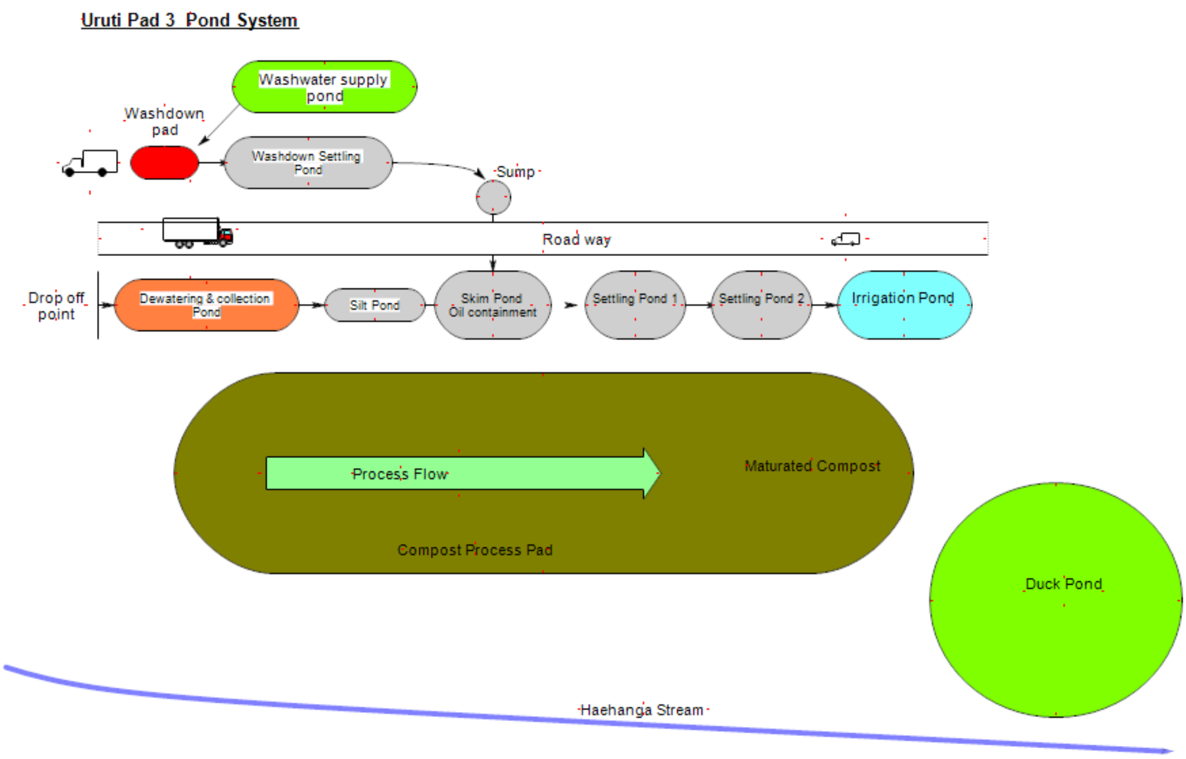
3.1 Pad 1

Figure 1: Pad 1



3.2 Pad 3

Figure 2: Pad 3



4.0 Pond Management Plan

4.1 Purpose of the Plan

This document describes the role of each pond system and provides instructions for the operation and maintenance for each system

4.2 Pond system inspection

Each pond is inspected daily to ensure the pond levels are maintained and there is no unplanned liquid overflow and the solids or sediment in each pond are below the planned maximum levels.

4.3 Dewatering and settling pond system

4.3.1 General

Organic waste is deposited onto Pad 1 or the mixing area. This organic waste is mixed with sawdust and greenwaste and deposited onto the compost pile. Surplus liquids are collected in the dewatering and collection pond. Liquids overflow into a series of settling and treatment ponds and eventually flow into the Irrigation pond. The pond levels are maintained by a series of T weirs at the pond discharge.

4.3.2 Operational and Maintenance

1) Dewatering and Collection Pond

   Monthly - Scoop out sediment from the pond and deposit onto the compost pile

2) Silt Pond

   Monthly – scoop out and deposit into the dewatering and collection pond

3) Skim Pond

   Monthly – skim hydrocarbons from the pond and deposit into the hydrocarbon collection tank

   Annually – Scoop out sediment and deposit into dewatering and collection pond

4) Settling pond 1 & 2

   Annually – Scoop out sediment and deposit into dewatering and collection pond

5) Irrigation pond

   Annually – Scoop out sediment and deposit into dewatering and collection pond

4.3.3 Duck pond

4.3.3.1 General

The duck pond maintains its level by ground soakage. Water from the duck pond is pumped into the irrigation pond during dry conditions to maintain dilution levels in the irrigation liquid and to the washdown supply pond to maintain minimum pond levels to provide washdown water during dry conditions.

4.3.4 Washdown settling pond

4.3.4.1 General

The washdown pad is used to clean trucks after they have dumped their load of organic waste. Wash water is pumped from the washdown supply pond. Runoff liquids from the wash are collected in the washdown settling pond and the pond overflow flows to the collection sump and then into the skim pond

4.3.4.2 Operational and Maintenance

Six monthly – scoop out sediment and deposit into dewatering and collection pond.

4.4 Irrigation Block Management Plan

4.4.1 Purpose of the Plan

The purpose of this document is to provide the methodology and procedures to ensure the waste water from the Irrigation Pond is irrigated onto the irrigation block in compliance with consent conditions

4.4.2 Resource Consent Conditions

Condition 8 The consent holder shall record the following information in association with irrigating waste water to land:
a) The date, time and hours of irrigation;
b) The volume of waste water irrigated to land;
c) The conductivity of the irrigation fluid (measured in mS/m)
d) The source of the waste water [e.g. Pond or Wetland Treatment System]; and
e) The location and extent where the wastewater was irrigated.

Condition 9 There shall be no direct discharge to water as a result of irrigating wastewater to land. This includes, but not necessarily limited to, ensuring the following:

a) No irrigation shall occur closer than 25 m to any surface water body;
b) The discharge does not result in surface ponding;
c) No spray drift enters surface water;
d) The discharge does not occur at a rate at which it cannot be assimilated by the soil/pasture system; and
e) The pasture cover within irrigation areas is maintained at all times.

Condition 10 treated wastewater discharged by irrigation to land shall not have a hydrocarbon content exceeding 5% total petroleum hydrocarbon or a sodium adsorption ratio exceeding 18.

Condition 11 Discharges irrigated to land shall not give rise to any of the following adverse effects on the Haehanga Stream, after a mixing zone extending 30 m from the downstream extent of the irrigation areas;

a) A rise in filtered carbonaceous biochemical oxygen demand of more than 2.00 gm-3,
b) A level of unionised ammonia greater than 0.0025 gm-3,
c) An increase in total recoverable hydrocarbons;
d) Chloride levels greater than 150g/m3
e) The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
f) Any conspicuous change in the colour visual clarity;

g) Any emissions of objectionable odour;
h) The rendering of fresh water unsuitable for consumption by farm animals; and
i) Any significant adverse effects on aquatic life.

4.4.3 Climate

NIWA virtual Climate Station -38.975, 174.525 Thirty years of rainfall and evaporation data is summarised in Table 1 below

Table 1: NIWA Virtual Climate Station 30-year data for a site near Uruti Site

Uruti	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Rainfall	120.0	107.0	119.2	151.2	181.2	189.5	181.8	178.0	175.4	188.4	149.4	149.0	1890.
Evaporation	134.5	108.0	88.6	52.7	31.1	21.4	25.4	39.0	57.5	85.1	109.3	126.0	878.6

4.4.4 Irrigation area

The Irrigation block consists of 8 areas as outlined in Appendix 22 as areas L1 to U3.

The area sizes are shown in Table 2 below

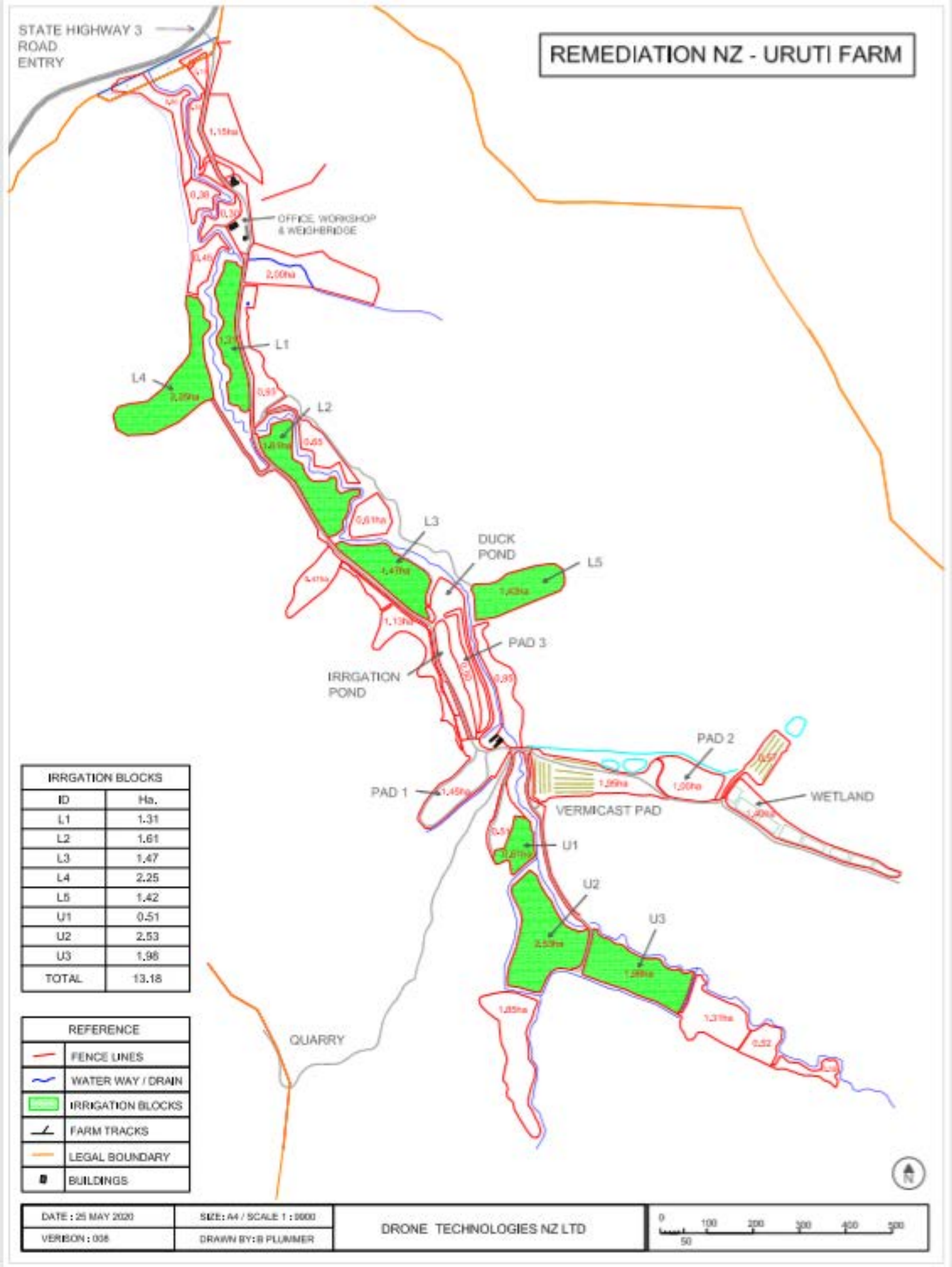
Table 2: Irrigation block areas

TRC	RNZ	Soil risk[1]	Ha
E	L1	Low risk	1.31
J	L2	Low risk	1.61
H	L3	Low risk	1.47
	L4	Low risk	2.25
	L5	Low risk	1.42
G	U1	High risk	0.61
	U2	High risk	2.53
F	U2	High risk	1.98
Total area			13.18

The locations of the 8 irrigation blocks are shown in figure 3 below

[1] Soil risk is discussed in "Irrigating High and Low risk Soils" refer to Appendix X

Figure 3: Irrigation areas



4.4.5 Soils

The soils in the effluent blocks were classified by BTW Company in the June 2015 report as Orthic brown soils from the Whangamomona Complex loams. A field survey by BTW Company using soil augers identified the top soil as Light brown grey silty clay and the subsoil as Light grey silty clay.

The soil texture was assessed by feel[2] during the KCL site visit as a silty loam as shown in Figure 1.

Figure 4: Photos showing test pit.

The assessment of the soils in the test pits indicated the top 300 mm of the soil profile consisted of 300 mm of a silty loam. The presence of mottles in the profile indicates that drainage is moderately drained.

4.4.6 Application Depth (Low risk soils)

It is important that the volume of effluent applied during each application does not exceed the water holding capacity of the soil in the plants root zone. The soil's Profile Available Water in the top 30 cm ($PAW_{30)}$ describes the maximum amount of water that can be held in the soil that is extractable by plants (i.e. plant available water).

The soils PAW_{30} was calculated using the methodology from the Farm Dairy Effluent Design Code of Practice FDEDCOP at 60 mm.

Industry good management practice is to restrict irrigation depth to less than 50% of PAW_{30}

Therefore, the maximum application depth is 30 mm.

As the irrigator does not distribute effluent evenly over the entire wetted area, in order to prevent over irrigating, the application depth is reduced by the distribution uniformity coefficient (DU). The FDEDCOP requires irrigators to achieve a DU of 1.25

Using a DU of 1.25 this gives an adjusted application depth **(Dt) of 25.0 mm.**

[2] Undertaken in general accordance with methodology described in 'Soil Description Handbook' Milne et al. (1995)

4.4.7 Application Rate (Low risk soils)

The FDE Design Code of Practice states that the maximum application rate must not exceed the soil infiltration rate. If effluent is applied at a rate greater than the soils infiltration capacity, effluent will pond on the soil surface and there is a risk of run off into surface water ways.

The soil infiltration rate was calculated using the methodology from the FDE Design Code of Practice at 15 mm/hr when using a watering time of 20 minutes.

Incorporating the losses gives a system design application rate **Ra = 15.00 mm/hr.**

4.4.8 Application Depth (High risk soils)

The principal applied to irrigation of high-risk soils is that it is important that the volume of effluent applied during each application does not exceed the soil water deficit.
The soil water deficit is calculated using a portable moisture probe.

The maximum application depth for high risk soils was calculated using the methodology from the FDE Design Code of Practice as:
The maximum application depth using a high rate irrigator (Travelling Irrigator) **(Dt) = 10 mm**
The maximum application depth using a low rate irrigator (Sprinkler pods) **(Dt) = 25 mm**

4.4.9 Application Rate (High risk soils)

The Farm Dairy Effluent (FDE) Design Code of Practice states that the maximum application rate must not exceed the soil infiltration rate. If effluent is applied at a rate greater than the soils infiltration capacity, effluent will pond on the soil surface and there is a risk of run off into surface water ways.

The soil infiltration rate for the subject site was calculated using the methodology from the FDE Design Code of Practice at 10 mm/hr.

The application depth for areas assessed as high risk should not exceed **Ra = 10.00 mm/hr**

4.4.10 Soil Chemistry

The BTW company report Uruti Composting Facility Management Plan (undated) developed a framework based on a three-tier decision tree which guides site operations in response to trigger levels of soil contaminants. The tiered response was developed because of its simplicity but also allows increased monitoring efforts and reviews of site performance to minimise risks from drainage to groundwater and accumulation of hydrocarbon constituents within the soil.

The three-tier framework is summarised in table 3 below.

Table 3: Three Tier response guidelines

Tier	Operation Status of irrigated area
One	Surveillance or normal operation of site
Two	Alert or increased level of monitoring with deferred irrigation
Three	Action or remediation options initiated and irrigation ceases

The trigger or threshold values and actions required are listed in the BTW company report in Appendix 23. The threshold values are summarised in table 4 below.

Table 4: Summary of the Three Tier threshold values for soil chemistry

Tier Level	Chloride	Total Petroleum Hydrocarbons (TPH)	SAR
	mg/kg	mg/kg	
One	0 – 700		0 – 6
Two	700 – 1,800	<20,000	6 – 18
Three	>1,800	>20,000	>18

4.4.11 Irrigation Model

The Irrigation Model is designed to proactively manage the pond levels. We receive predicted 14-day rainfall data from a Weather Forecaster on a weekly basis. We receive this data on Monday mornings and using the predicted rainfall data calculate the volume of stormwater that is predicted to arrive in the irrigation pond during the following week i.e. days 8 to 14. The irrigation plan is updated each Monday morning to account for this volume and the pond level is reduced during the week by irrigation to a level at the end of the week where the pond will have sufficient capacity to cope with the following weeks predicted rainfall.

We also receive a 3-monthly forecast which predicts the weather to be wetter than normal, normal or wetter than normal. The average rainfall data is entered into the model and multiplied by a correction factor to account for 3-month prediction e.g. normal = 0, wetter than normal + 10% and drier than normal = -10%.

The irrigation model is attached in Appendix 24

4.4.12 Standard Workplace Instruction

The Standard Workplace Instruction SWPI_RU-740-020-A provides instructions on how to operate the irrigation system so to achieve the design application depth and rate specific to the areas of high and low risk soil. Refer to Appendix 25

			May	June	July	August	September	October	November	December	January	February	March	April	April	
Uruti Irrigation Model v2.0		Month	May	June	July	August	September	October	November	December	January	February	March	April	April	
	Days in Month		28	28	28	28	28	28	28	28	28	28	28	28	28	364
Uruti Virtual Climate Station	Evaporation mm	Average	31.12	21.41	25.43	39.04	57.48	85.05	109.32	126.01	134.46	107.97	88.65	52.65	52.65	878.60
	Rain mm/day		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(878.60)
	13 Month Calendar		**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**1**	**2**	**3**	**4**	**5**	
Predicted Rainfall	Week 1	Predicted	0.95	11.46	28.48	35.90	19.35	16.50	26.92	37.68	1.63	7.55	3.20	8.93	4.06	
	Week 2	Predicted	32.30	0.00	3.34	29.15	3.41	18.30	10.53	17.33	12.55	3.80	13.86	0.00	19.92	
	Week 3	Predicted	25.74	37.71	20.19	26.02	26.08	11.11	9.23	51.22	0.00	3.99	12.12	37.56	17.23	
	Week 4	Predicted	9.68	23.60	48.98	22.75	30.23	12.32	1.07	19.64	2.30	13.07	15.38	17.75	8.02	
		Predicted	68.67	72.77	100.99	113.82	79.07	58.23	47.75	125.87	16.48	28.41	44.56	64.24	49.23	870.09
			68.67	72.77	100.99	113.82	79.07	58.23	47.75	125.87	16.48	28.41	44.56	64.24	49.23	870.09
Rainfall falling onto the pads & ponds	Week 1		68.42	168.53	330.63	401.30	243.67	216.53	315.77	418.26	74.90	131.28	89.85	144.43	98.04	2,701.63
	Week 2		367.02	59.38	91.19	337.01	91.85	233.67	159.67	224.43	178.91	95.57	191.38	59.38	249.10	2,338.56
	Week 3		304.54	418.54	251.67	307.20	307.77	165.19	147.29	547.22	59.38	97.38	174.81	417.12	223.48	3,421.59
	Week 4		151.57	284.15	525.89	276.06	347.30	176.72	69.57	246.44	81.28	183.86	205.86	228.43	135.76	2,912.89
			891.55	930.60	1,199.38	1,321.58	990.60	792.11	692.29	1,436.35	394.46	508.09	661.91	849.35	706.39	11,374.67
																-
Less evaporation = Amount to be irrigated	Week 1		(105.76)	(142.83)	(300.12)	(354.46)	(174.70)	(114.46)	(184.59)	(267.04)	86.45	(1.72)	16.52	(81.25)	(34.86)	(1,658.81)
	Week 2		(329.68)	(33.68)	(60.67)	(290.17)	(22.88)	(131.61)	(28.48)	(73.22)	(17.55)	34.00	(85.01)	3.81	(185.92)	(1,221.06)
	Week 3		(267.20)	(392.85)	(221.16)	(260.36)	(238.80)	(63.13)	(16.10)	(396.00)	101.98	32.19	(68.44)	(353.93)	(160.30)	(2,304.09)
	Week 4		(114.23)	(258.46)	(495.37)	(229.21)	(278.32)	(74.65)	61.62	(95.22)	80.07	(54.29)	(99.49)	(165.25)	(72.58)	(1,795.39)
																(6,979.36)
			(816.87)	(827.83)	(1,077.32)	(1,134.19)	(714.70)	(383.85)	(167.55)	(831.49)	250.95	10.19	(236.41)	(596.63)	(453.66)	(6,979.36)
	Planned irrigation	Month	1,860.00	1,860.00	1,833.00	1,745.00	1,823.00	1,806.00	1,453.00	1,413.00	861.00	1,060.00	919.00	1,557.00	1,557.00	19,747.00
		Week	465.00	465.00	458.25	436.25	455.75	451.50	363.25	353.25	215.25	265.00	229.75	389.25	389.25	4,936.75
Volume irrigated	Week 1	Entered	105.76	142.83	300.12	354.46	174.70	114.46	184.59	267.04	(86.45)	1.72	(16.52)	81.25	34.86	1,658.81
	Week 2	Entered	329.68	33.68	60.67	290.17	22.88	131.61	28.48	73.22	17.55	(34.00)	85.01	(3.81)	185.92	
	Week 3	Entered	267.20	392.85	221.16	260.36	238.80	63.13	16.10	396.00	(101.98)	(32.19)	68.44	353.93	160.30	
	Week 4	Entered	114.23	258.46	495.37	229.21	278.32	74.65	(61.62)	95.22	(80.07)	54.29	99.49	165.25	72.58	
			816.87	827.83	1,077.32	1,134.19	714.70	383.85	167.55	831.49	(250.95)	(10.19)	236.41	596.63	453.66	6,979.36
Pumping hours required per week	Week 1	Pumping	**3.5**	**4.8**	**10.0**	**11.8**	**5.8**	**3.8**	**6.2**	**8.9**	**(2.9)**	**0.1**	**(0.6)**	**2.7**	**1.2**	
	Week 2	Pumping	**11.0**	**1.1**	**2.0**	**9.7**	**0.8**	**4.4**	**0.9**	**2.4**	**0.6**	**(1.1)**	**2.8**	**(0.1)**	**6.2**	
	Week 3	Pumping	**8.9**	**13.1**	**7.4**	**8.7**	**8.0**	**2.1**	**0.5**	**13.2**	**(3.4)**	**(1.1)**	**2.3**	**11.8**	**5.3**	
	Week 4	Pumping	**3.8**	**8.6**	**16.5**	**7.6**	**9.3**	**2.5**	**(2.1)**	**3.2**	**(2.7)**	**1.8**	**3.3**	**5.5**	**2.4**	
			27.2	**27.6**	**35.9**	**37.8**	**23.8**	**12.8**	**5.6**	**27.7**	**(8.4)**	**(0.3)**	**7.9**	**19.9**	**15.1**	232.65
Actual pumping hours		30	37.00	65.00	76.00	65.50	91.00	66.50	24.00	34.00	19.00	29.00	22.00	33.00	59.00	621.00
Actual pumping volume m3			1,110.00	1,950.00	2,280.00	1,965.00	2,730.00	1,995.00	720.00	1,020.00	570.00	870.00	660.00	990.00	1,770.00	18,630.00
Pond freeboard storage (M^3) at 1st day of month																
Surplus liquid			1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	
Pond vol at end of month			-	-	-	-	-	-	-	-	-	-	-	-	-	
Pond vol per metre			1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	
Pond depth (at beginning of month)			1,300.0	1,300.0	1,300.0	1,300.0	1,300.0	1,300.0	1,300.0	1,300.0	1,300.0	1,300.0	1,300.0	1,300.0	1,300.0	
Pond depth (at end of 4 week month)			-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	
			-0.769	-0.769	-0.769	-0.769	-0.769	-0.769	-0.769	-0.769	-0.769	-0.769	-0.769	-0.769	-0.769	
			6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**1**	**2**	**3**	**4**	**5**	

1.0 PURPOSE

1.1 "The purpose of this document is to provide instructions for the safe and compliant irrigation from the leachate/irrigation pond adjacent to Pad 3.

2.0 SCOPE

2.1 This instruction covers the spreading of the irrigation liquid onto the irrigation areas.

3.0 RECORDS

3.1 Specific records to be kept are-

- 3.1.1 Time and date of irrigation
- 3.1.2 Area irrigated
- 3.1.3 Time irrigation applied
- 3.1.4 Soil Moisture Deficit
- 3.1.5 Method of irrigation ie travelling irrigator, pods, tractor trailer
- 3.1.6 Weather at time of irrigation
- 3.1.7 Irrigation pond level at end of irrigation

4.0 ASSOCIATED DOCUMENTS

4.1 Uruti Integrated Management Plan
4.2 TRC Consent's
4.3 Irrigating High & Low risk Soils
4.4 Leachate & Stormwater Management Plan

5.0 DEFINITIONS

5.1 L1-L5: Lower irrigation areas
5.2 U1-U3: Upper irrigation areas
5.3 Irrigation Catchment Pond: Final pond adjacent to Pad 3-collects leachate and stormwater from Pad 1, 3 and washdown.

6.0 RESPONSIBILITY

6.1 The Uruti Site Manager is responsible for ensuring this SWPI is followed

7.0 TOOLS, GAUGES, FIXTURES

7.1 Fixed diesel driven pump at irrigation pond
7.2 Pond aeration manifold
7.3 Testing equipment for TKN in irrigation pond

8.0 SAFETY REQUIREMENTS

8.1 Hi Vis to be worn on site
8.2 Sun protection to be worn
8.3 Safety glasses to be worn when starting/stopping pump

9.0 INSTRUCTIONS (General)

9.1 Identify irrigation requirements-this is based on maintaining the irrigation pond with a 1m freeboard

9.2 On Monday mornings the two week rain forecast is received from 'WeatherWatch', a professional weather forecasting business.

9.3 The irrigation model is updated using this information and emailed to Uruti.

9.4 The Uruti Site operator records the level in the irrigation pond Monday morning.

9.5 The Site Manager plans the weeks irrigation based on the irrigation pond level, the rain forecast, and the application rate (rates are attached see Irrigation Areas/Rates). This information is posted on the operators planning notice board. Information provided is:

- 9.5.1 Days to irrigate
- 9.5.2 Areas to be irrigated
- 9.5.3 Time of irrigation each area
- 9.5.4 Hours aeration of irrigation pond (normally a minimum of 2 hours per day).

9.6 Irrigation is spread as evenly as possible over all irrigation areas. Depending on the soil tests an area may be spelled for a period.

10.0 INSTRUCTIONS (PUMP AND IRRIGATORS)

10.1 Pods are generally used for irrigation of the upper areas

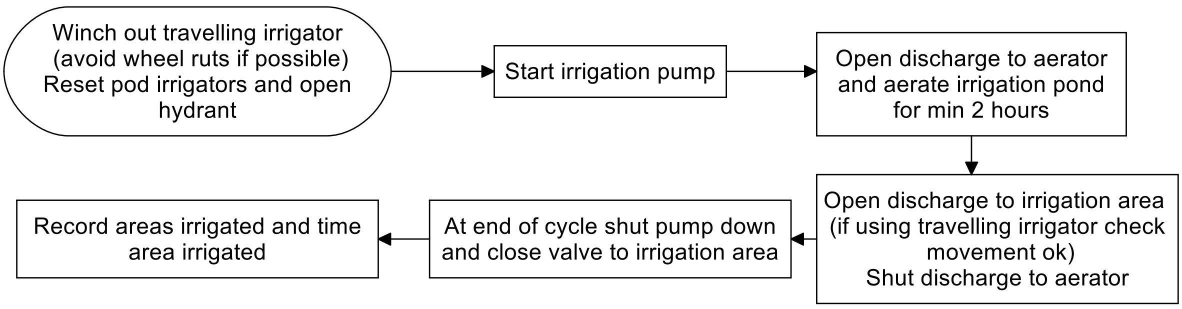
10.2 Use soil moisture probe to calculate the soil moisture deficit

10.3 Adjust the irrigator time to not exceed the soil moisture deficit

10.4 Travelling irrigator & Sprinkler pods can be used for irrigation of lower areas

10.5 Irrigation Flow Chart

<u>Irrigation Flow Chart</u>



Note: In wet conditions travelling irrigator set in high gear (1 hr to cycle)
In dry conditions set in low gear(3.5hr to cycle)
Travelling irrigator shuts down automatically when cycle finished
Pods may have to be moved netween irrigation areas

Figure 1: Irrigation Flow Chart

10.6 Irrigation maximum application rate

The irrigator is to be operated to match the soil risk and moisture conditions in the irrigation area.

- Low risk soils – Areas L1, L2, L3, L4 & L5
- The maximum application rate is 15 mm/hr
- The maximum application depth is 25 mm
- Use Travelling irrigator and Sprinkler pods

10.7 Irrigation maximum depth

The irrigator is to be operated to match the soil risk and moisture conditions in the irrigation area.

- High risk soils – Areas U1, U2 & U3
- The maximum application rate is 10 mm/hr
- The maximum application depth is 25 mm
- Use Sprinkler pods

10.8 Operating the Travelling Irrigator

The Travelling irrigator is capable of operating at 12 mm/hr with a 40 m diameter cover

- To achieve a 20 mm application depth the minimum speed must exceed 20 m/hour
- Engage Gear 2 to achieve 20 m/hr

10.9 Operating the Uni Sprinkler pods

The Uni Sprinkler with a 9 mm nozzle operating at 2 bar pressure will apply 4 mm/hr

- To apply 24 mm the pods should be operated for a maximum of 6 hours.

Uruti Irrigation Pumping System

Pump Suction Manifold

Pump Discharge Manual

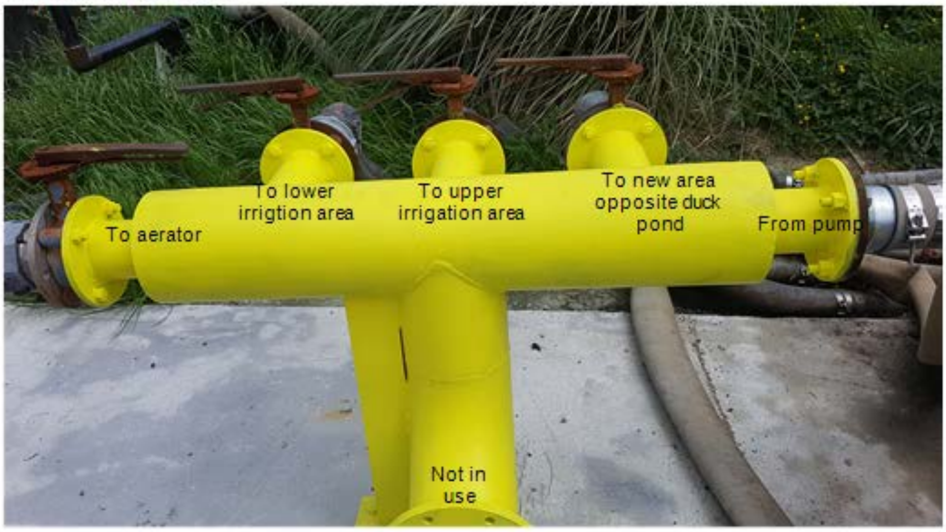
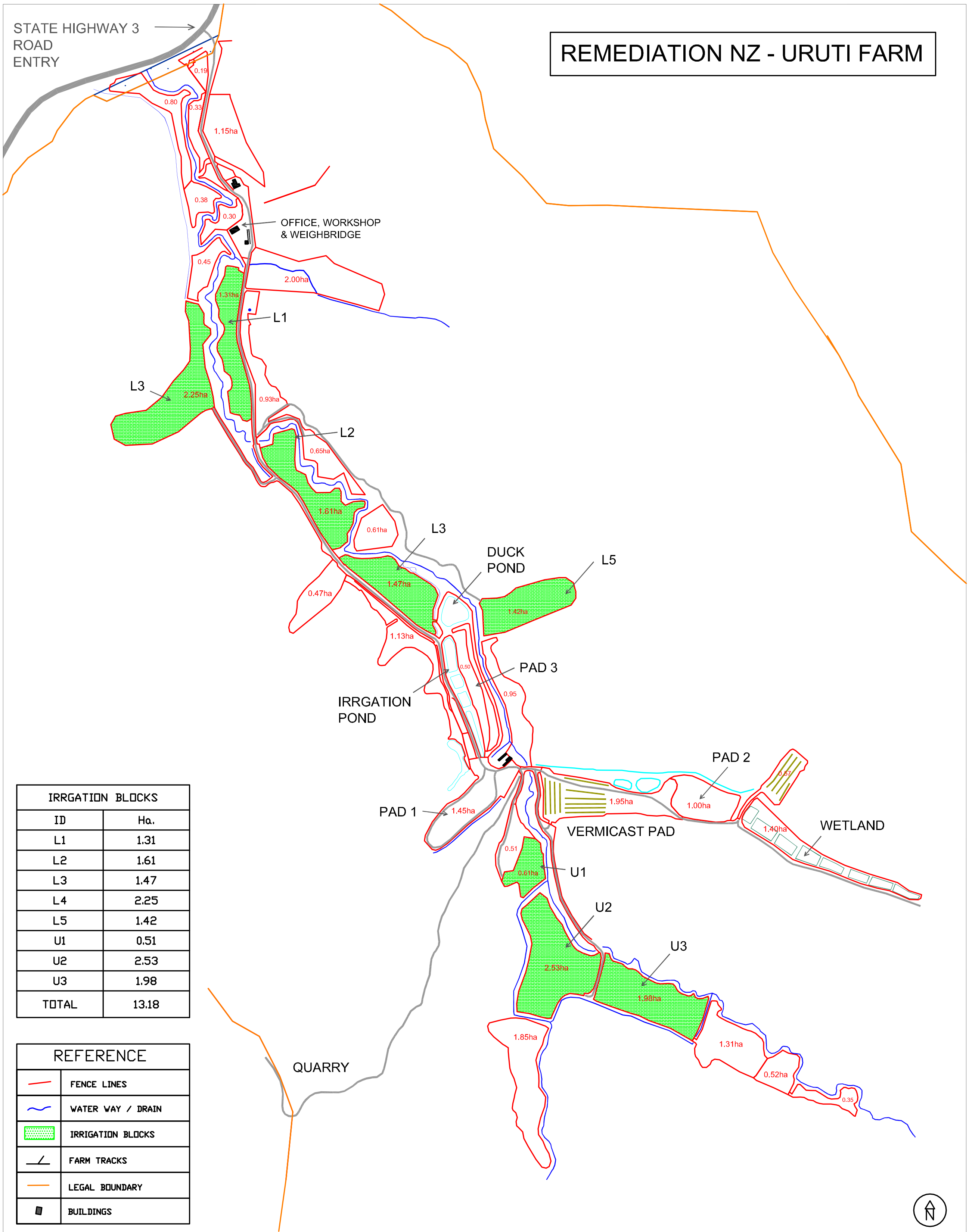


Figure 2: Pump Suction and discharge Manifold

REMEDIATION NZ - URUTI FARM



IRRGATION BLOCKS	
ID	Ha.
L1	1.31
L2	1.61
L3	1.47
L4	2.25
L5	1.42
U1	0.51
U2	2.53
U3	1.98
TOTAL	13.18

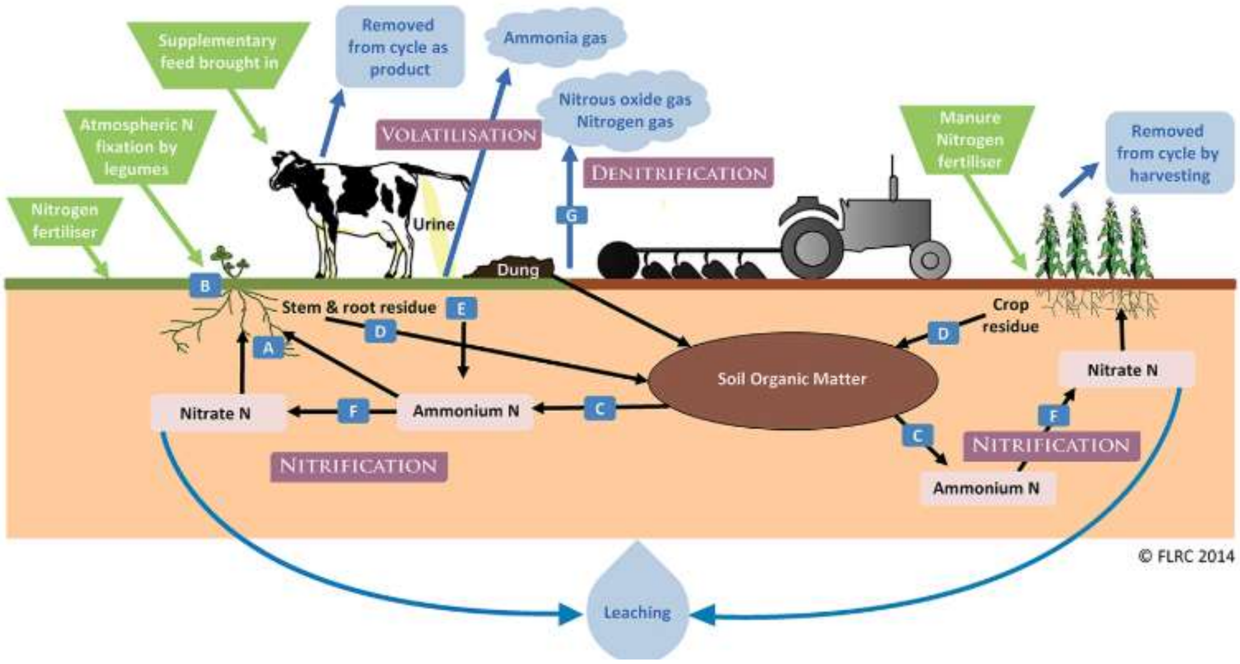
REFERENCE	
	FENCE LINES
	WATER WAY / DRAIN
	IRRIGATION BLOCKS
	FARM TRACKS
	LEGAL BOUNDARY
	BUILDINGS

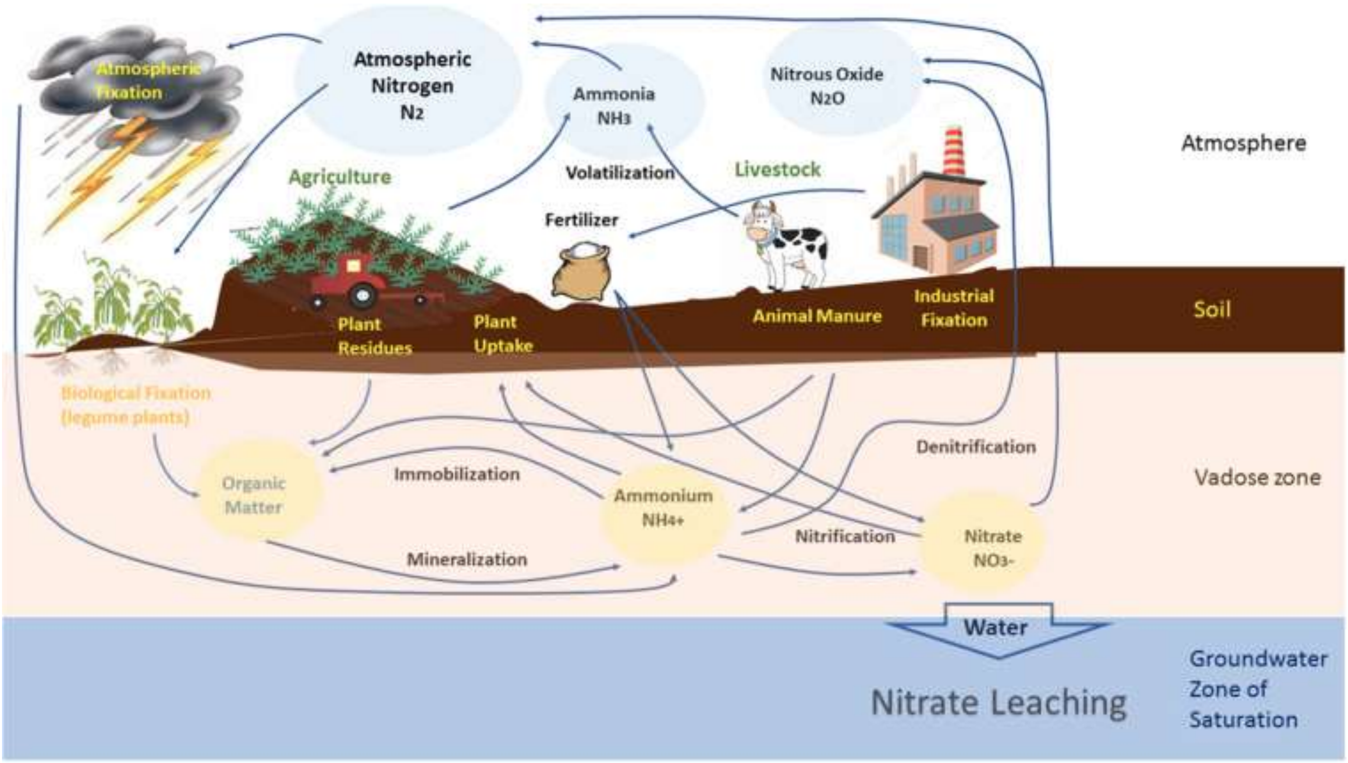
DATE : 25 MAY 2020	SIZE: A4 / SCALE 1:9900	DRONE TECHNOLOGIES NZ LTD	0 100 200 300 400 500 50
VERISON : 005	DRAWN BY: B PLUMMER		

Appendix 2 – Nitrogen Cycle

Nitrogen Cycle

Figure 1. Inputs, outputs and transformations of nitrogen in farming systems





Appendix 3 - Overseer 2022

Uruti Composting Facility

Uruti, New Zealand

OverseerFM

2022

Analysis type	Predictive
Is publication	No
Application version	3.1.0.3
Printed date	15 Jun, 2020, 9:21AM
Model version	6.3.3

Farm details

N: 2288 N/ha: 4 P: 133 P/ha: 0.2 GHG/ha: 100 NCE: 56% v6.3.3

Total area	641 ha
Productive block area	13.20 ha
Nitrogen conversion efficiency (NCE)	56%
N Surplus	4 kg/ha
Region	Taranaki

Blocks

NAME	TYPE	AREA (HA)	N LOSS	N LOSS/HA	N SURPLUS/HA	P LOSS	P LOSS/HA
Lower irrigation	Cut and carry	8.1	621	77	110	1	0.2
Upper Irrigation	Cut and carry	5.1	404	79	110	1	0.2
Other sources	Other	-	1263	-	-	130	-

Farm soils

S-MAP REF	GROUP/ORDER	DRAINAGE CLASS	MODIFIED	TOTAL AREA (HA)	% OF PROD. BLOCKS	BLOCKS
-	Sedimentary/Brown	Moderately well	Yes	8.1	61.4	1
-	Sedimentary/Brown	Poor	Yes	5.1	38.6	1

Enterprises

STOCK NUMBERS

There are no animal enterprises on this farm.

RSU

There are no animal enterprises on this farm.

Irrigators

NAME	AREA COVERED	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
TRAVELLING IRRIGATOR Irrigator 1	0 ha												

Structures

No structures exist

No structures exist.

Supplements

CATEGORY	FEED	SOURCE	DRY WEIGHT?	SOURCED	DISTRIBUTED	REMAINING	DESTINATION
Baleage	-	Lower irrigation (30.9)	Yes	30.9 tonnes	30.9 tonnes	0	Off farm (30.9)
Baleage	-	Upper Irrigation (19.6)	Yes	19.6 tonnes	19.6 tonnes	0	Off farm (19.6)
Baleage	-	Lower irrigation (40.2)	Yes	40.2 tonnes	40.2 tonnes	0	Off farm (40.2)
Baleage	-	Lower irrigation (27.8)	Yes	27.8 tonnes	27.8 tonnes	0	Off farm (27.8)
Baleage	-	Lower irrigation (21.6)	Yes	21.6 tonnes	21.6 tonnes	0	Off farm (21.6)
Baleage	-	Upper Irrigation (25.5)	Yes	25.5 tonnes	25.5 tonnes	0	Off farm (25.5)
Baleage	-	Upper Irrigation (17.7)	Yes	17.7 tonnes	17.7 tonnes	0	Off farm (17.7)
Baleage	-	Upper Irrigation (13.8)	Yes	13.8 tonnes	13.8 tonnes	0	Off farm (13.8)

Crops

CROP/PASTURE	AREA (HA)	YIELD	GROWN (T/DM/YR)	INTAKE (T/DM/YR)	SUPPLEMENTS (T/DM/YR)
Grass only	13.2	-	197	-	197

Fertiliser

MANUFACTURER/MATERIAL	NAME	TOTAL APPLIED (KG)	N	P	K	S	CA	MG	NA
Custom soluble fertiliser	Irrigation Pond (Fertigation)	-	4,561	286	14,296	-	-	-	-
TOTAL		**0**	**4,561**	**286**	**14,296**	-	-	-	-

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	2,288	4
Phosphorus	133	0.2

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	7	0	22	0	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements	0	0	0	0	0	0	0
Rain/clover fixation	3	0	4	7	5	11	65

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	4	0.2	6	7	6	11	64
As product	0	0	0	0	0	0	0
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0

	N	P	K	S	CA	MG	NA
To atmosphere	1	0	0	0	0	0	0
As supplements and crop residues	5	1	6	1	1	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	0	0	0	-1	0	0	0
Inorganic mineral	0	0	0	0	0	0	0
Inorganic soil pool	0	0	13	0	-2	0	1

Blocks

Lower irrigation

Cut and carry - Flat, 8.1ha

N loss: 621 N loss/ha: 77 P loss: 1 P loss/ha: 0.2

BLOCK DETAILS

Area	8.1 ha	Average temp	13.5° C	Average rainfall	1798 mm/yr	Annual PET	867 mm
Distance from coast	7 km						

SOILS

100% BROWN
8.1 ha

ARTIFICIAL DRAINAGE

Drainage method	None

SUPPLEMENTS

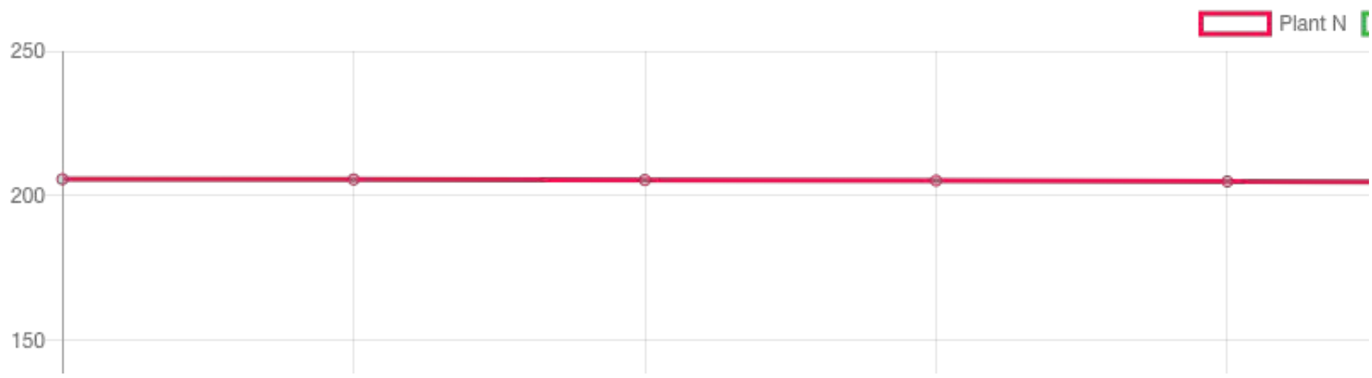
Harvested (DM)	120.5 tonnes

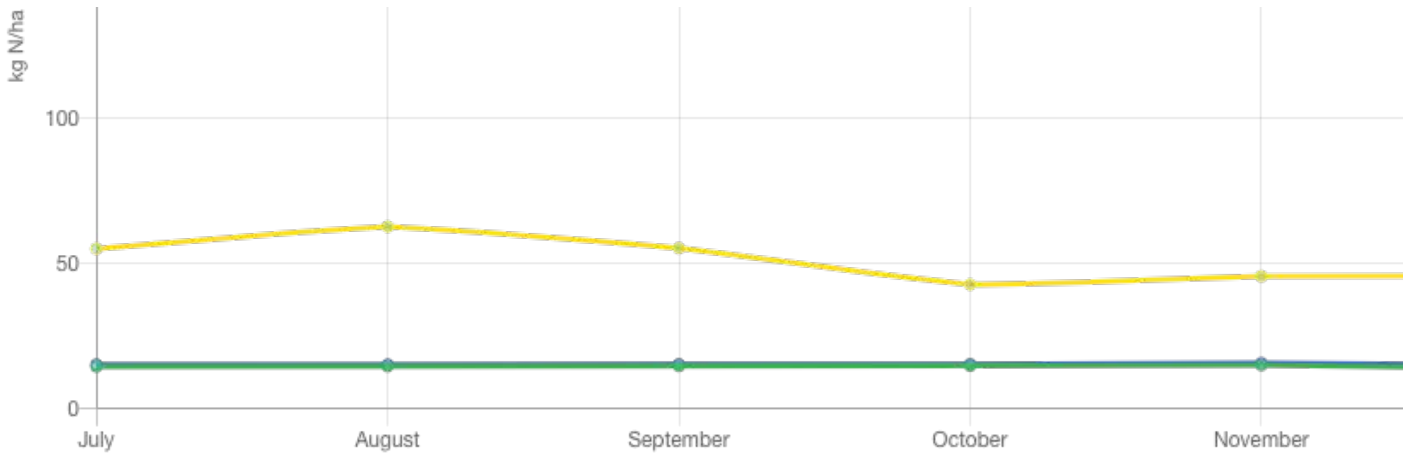
CROP MANAGEMENT

Block type	Pasture	Cultivated in last 5 years	Yes
Topography	Flat	Animals present	No
Pasture type	Grass only		

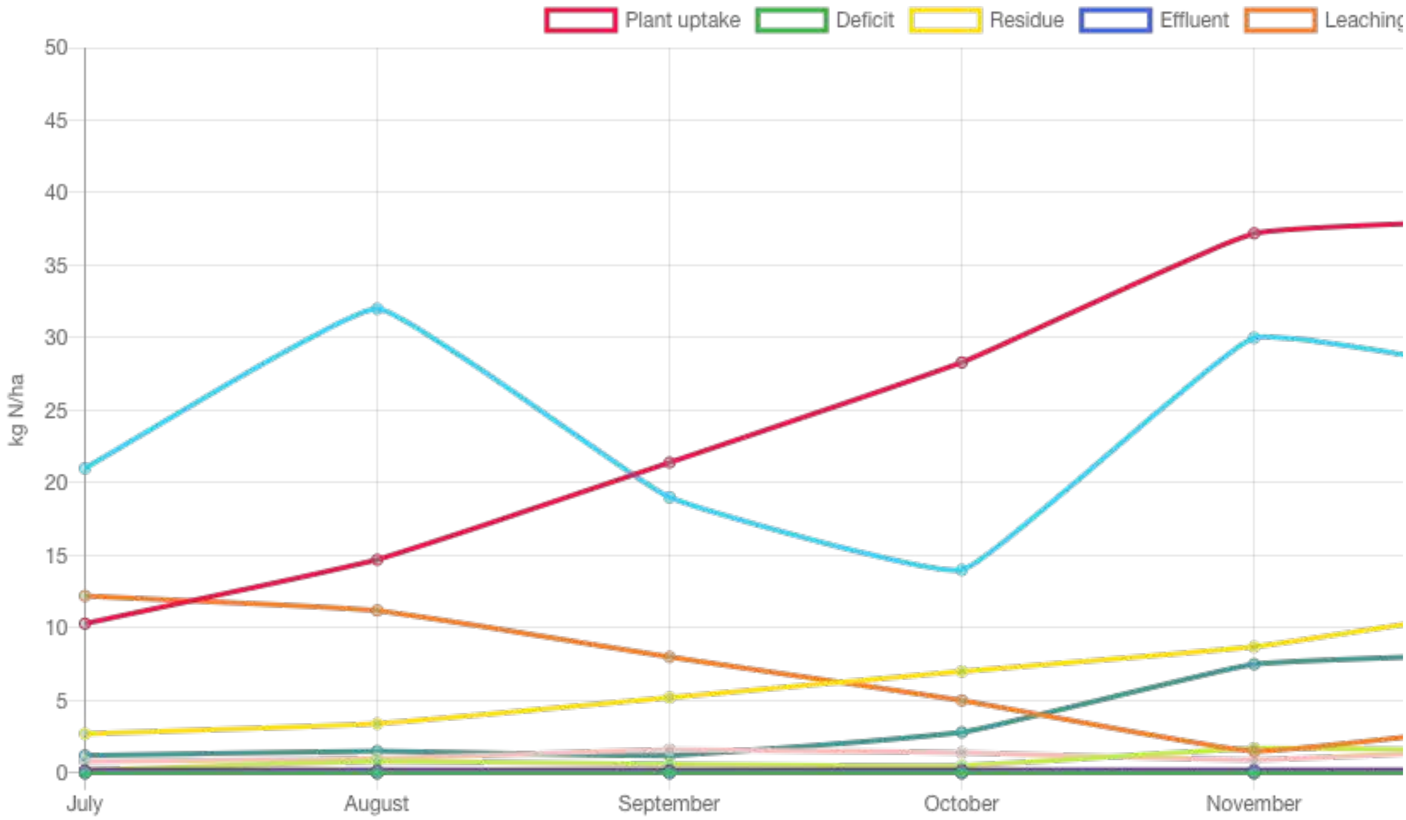
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
FERTILISER APPLIED (KG/HA)												
N	-	-	-	-	-	-	-	-	-	-	-	-
P	-	-	-	-	-	-	-	-	-	-	-	-
K	169	162	95	60	79	63	41	54	95	104	96	65
S	-	-	-	-	-	-	-	-	-	-	-	-

Nitrogen pools





Change in nitrogen pools



RESULTS BY SOIL AND IRRIGATION

				NITROGEN					PHOSPHORUS		P LOSS CATE	
SOIL	IRRIGATOR	PERCENTAGE	AREA	TOTAL LOST	LOST	DRAINAGE	SURPLUS	ADDED	TOTAL LOST	LOST	SOIL	FERTILISER
Brown	No irrigation	100%	8.1 ha	621 kg	77 kg/ha	7.7 ppm	110 kg/ha	346 kg/ha	1 kg	0.2 kg/ha	N/A	N/A

					TO 60CM				T	
SOIL	IRRIGATOR	PERCENTAGE	DRAINAGE	RUNOFF	FIELD CAPACITY	WILTING POINT	SATURATION	PAW	FIELD CAPACITY	WILT
Brown	No irrigation	100%	998 mm	0 mm	193 mm	90 mm	299 mm	103 mm	-	-

MODEL NOTES

Overview

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

- Decrease in Olsen P test of 3 units

- Increase in QT K test of 11 units
- Increase in QT Mg test of 1 units

The change in inorganic soil pool indicates that fertiliser nutrients can be reduced for K

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

NUTRIENT BUDGET

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	621	77
Phosphorus	1	0.2

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Effluent added	0	0	0	0	0	0	0
Fertiliser, lime and other	346	21	1083	0	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements fed on blocks	0	0	0	0	0	0	0
Rain/clover fixation	26	0	4	9	7	16	96

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	77	0.2	131	12	60	4	39
To atmosphere	33	0	0	0	0	0	0
As Supplements	262	27	314	28	45	8	7

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	0	9	0	-31	0	0	0
Inorganic mineral	0	1	-3	0	-2	-3	-4
Inorganic soil pool	0	-16	645	0	-97	7	54

Upper Irrigation

Cut and carry - Flat, 5.1ha

N loss: 404 N loss/ha: 79 P loss: 1 P loss/ha: 0.2

BLOCK DETAILS

Area	5.1 ha	Average temp	13.3° C	Average rainfall	1866 mm/yr	Annual PET	856 mm
Distance from coast	7 km						

SOILS

100% BROWN
5.1 ha

ARTIFICIAL DRAINAGE

Drainage method None

SUPPLEMENTS

Harvested (DM) 76.6 tonnes

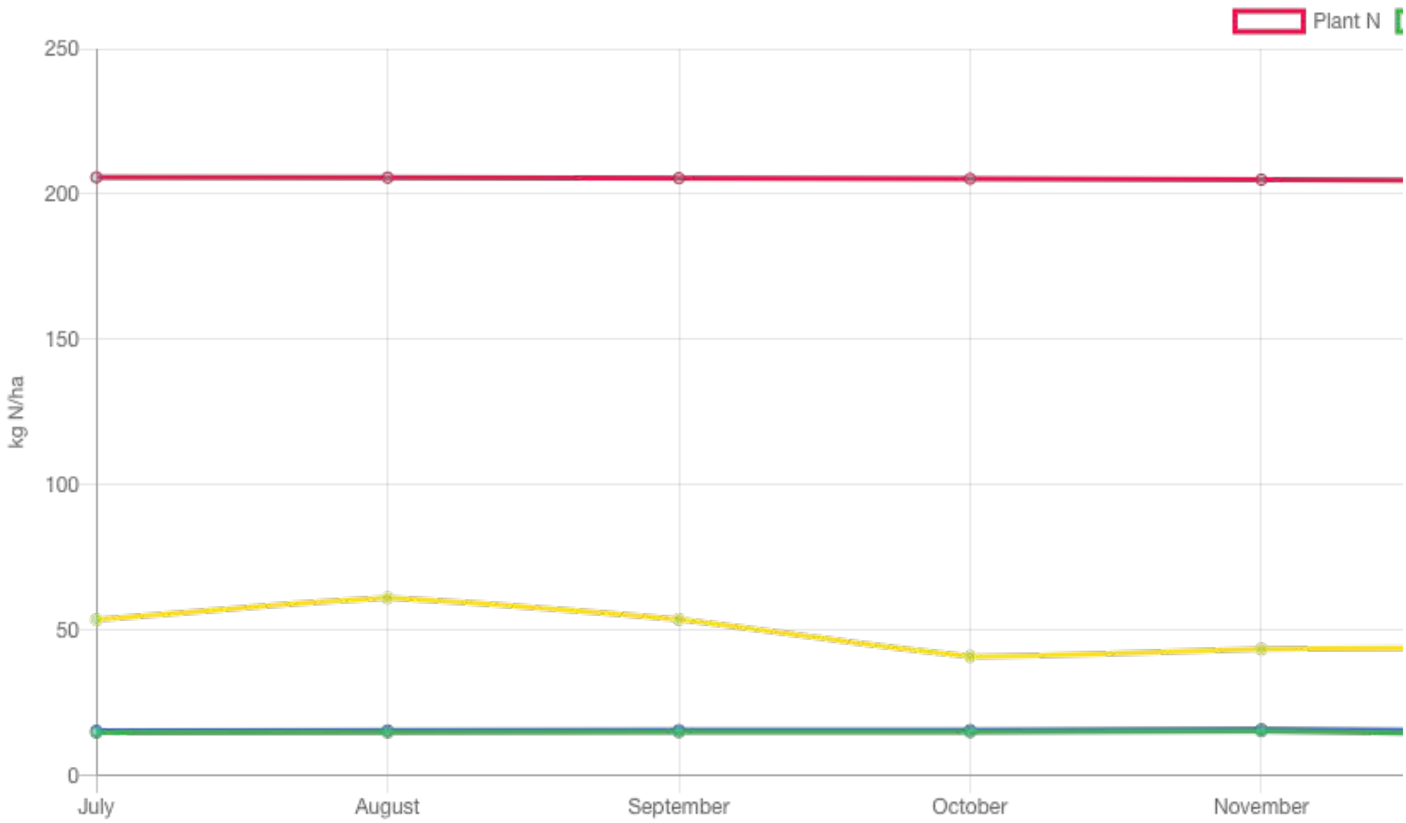
CROP MANAGEMENT

Block type	Pasture	Cultivated in last 5 years	Yes
Topography	Flat	Animals present	No

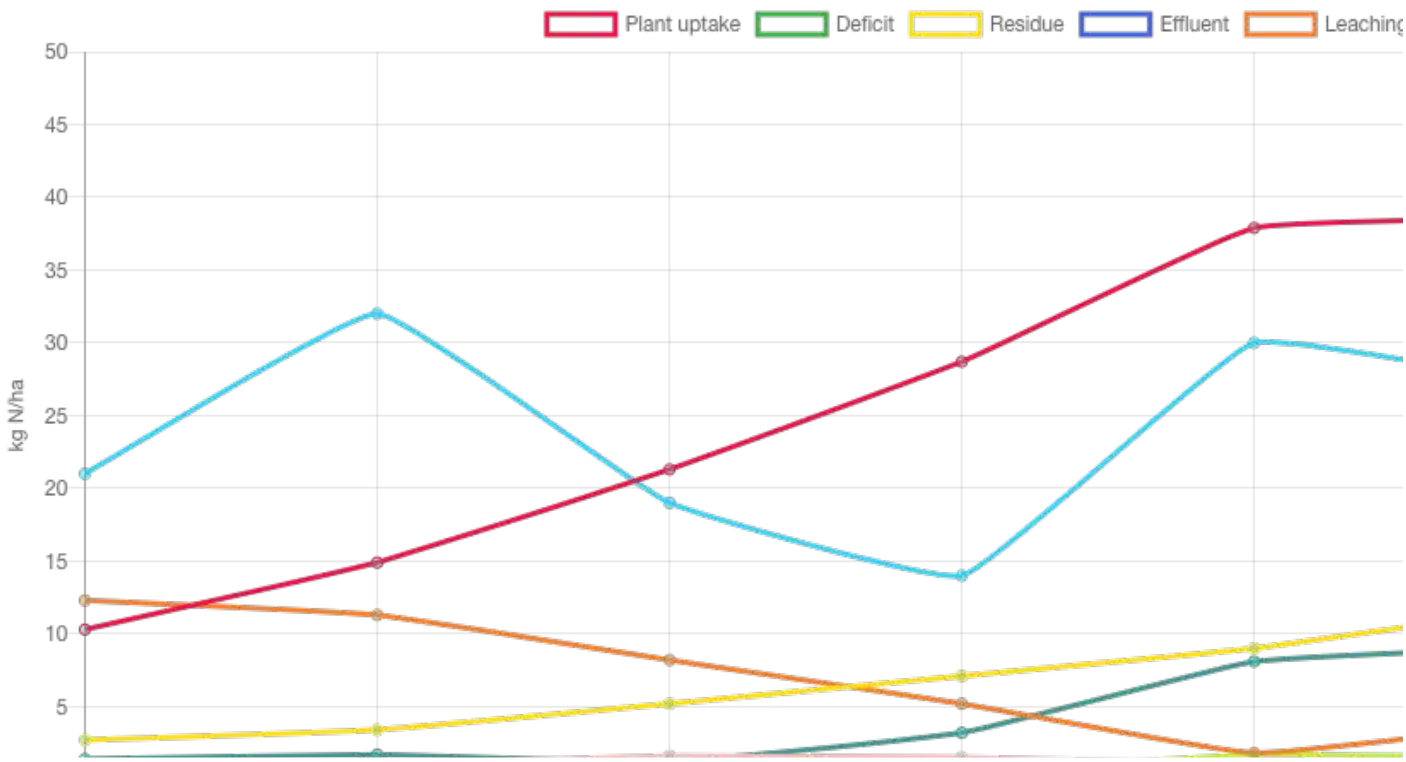
Pasture type	Grass only

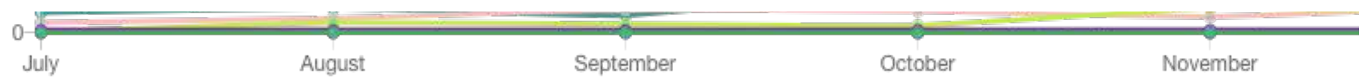
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
FERTILISER APPLIED (KG/HA)												
N	-	-	-	-	-	-	-	-	-	-	-	-
P	-	-	-	-	-	-	-	-	-	-	-	-
K	169	162	95	60	79	63	41	54	95	104	96	65
S	-	-	-	-	-	-	-	-	-	-	-	-

Nitrogen pools



Change in nitrogen pools





RESULTS BY SOIL AND IRRIGATION

				NITROGEN					PHOSPHORUS		P LOSS CATE	
SOIL	IRRIGATOR	PERCENTAGE	AREA	TOTAL LOST	LOST	DRAINAGE	SURPLUS	ADDED	TOTAL LOST	LOST	SOIL	FERTILISEF
Brown	No irrigation	100%	5.1 ha	404 kg	79 kg/ha	7.4 ppm	110 kg/ha	346 kg/ha	1 kg	0.2 kg/ha	N/A	N/A

					TO 60CM				T	
SOIL	IRRIGATOR	PERCENTAGE	DRAINAGE	RUNOFF	FIELD CAPACITY	WILTING POINT	SATURATION	PAW	FIELD CAPACITY	WILT
Brown	No irrigation	100%	1076 mm	0 mm	193 mm	90 mm	299 mm	103 mm	-	-

MODEL NOTES

Overview

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

- Decrease in Olsen P test of 3 units
- Increase in QT K test of 11 units
- Increase in QT Mg test of 1 units

The change in inorganic soil pool indicates that fertiliser nutrients can be reduced for K

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

NUTRIENT BUDGET

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	404	79
Phosphorus	1	0.2

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Effluent added	0	0	0	0	0	0	0
Fertiliser, lime and other	346	21	1083	0	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements fed on blocks	0	0	0	0	0	0	0
Rain/clover fixation	29	0	4	9	7	17	100

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	79	0.2	131	11	62	5	44
To atmosphere	33	0	0	0	0	0	0
As Supplements	265	28	317	29	46	9	7

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	-2	9	0	-31	0	0	0
Inorganic mineral	0	1	-3	0	-2	-3	-4
Inorganic soil pool	0	-17	642	0	-99	6	53

Appendix 4 - Overseer 2022 + 1,000m^3 compost

Uruti Composting Facility
Uruti, New Zealand

OverseerFM

2022 + compost 1000m3

Analysis type	Scenario
Is publication	No
Application version	3.1.0.3
Printed date	15 Jun, 2020, 9:19AM
Model version	6.3.3

Farm details

N: 3356 N/ha: 5 P: 134 P/ha: 0.2 GHG/ha: 147 NCE: 47% v6.3.3

Total area	641 ha
Productive block area	13.20 ha
Nitrogen conversion efficiency (NCE)	47%
N Surplus	6 kg/ha
Region	Taranaki

Blocks

NAME	TYPE	AREA (HA)	N LOSS	N LOSS/HA	N SURPLUS/HA	P LOSS	P LOSS/HA
Lower irrigation	Cut and carry	8.1	1435	177	216	2	0.2
Upper Irrigation	Cut and carry	5.1	658	129	197	2	0.3
Other sources	Other	-	1263	-	-	130	-

Farm soils

S-MAP REF	GROUP/ORDER	DRAINAGE CLASS	MODIFIED	TOTAL AREA (HA)	% OF PROD. BLOCKS	BLOCKS
-	Sedimentary/Brown	Moderately well	Yes	8.1	61.4	1
-	Sedimentary/Brown	Poor	Yes	5.1	38.6	1

Enterprises

STOCK NUMBERS

There are no animal enterprises on this farm.

RSU

There are no animal enterprises on this farm.

Irrigators

NAME	AREA COVERED	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
TRAVELLING IRRIGATOR Irrigator 1	0 ha												

Structures

No structures exist

No structures exist.

Supplements

CATEGORY	FEED	SOURCE	DRY WEIGHT?	SOURCED	DISTRIBUTED	REMAINING	DESTINATION
Baleage	-	Lower irrigation (30.9)	Yes	30.9 tonnes	30.9 tonnes	0	Off farm (30.9)
Baleage	-	Upper Irrigation (19.6)	Yes	19.6 tonnes	19.6 tonnes	0	Off farm (19.6)
Baleage	-	Lower irrigation (40.2)	Yes	40.2 tonnes	40.2 tonnes	0	Off farm (40.2)
Baleage	-	Lower irrigation (27.8)	Yes	27.8 tonnes	27.8 tonnes	0	Off farm (27.8)
Baleage	-	Lower irrigation (21.6)	Yes	21.6 tonnes	21.6 tonnes	0	Off farm (21.6)
Baleage	-	Upper Irrigation (25.5)	Yes	25.5 tonnes	25.5 tonnes	0	Off farm (25.5)
Baleage	-	Upper Irrigation (17.7)	Yes	17.7 tonnes	17.7 tonnes	0	Off farm (17.7)
Baleage	-	Upper Irrigation (13.8)	Yes	13.8 tonnes	13.8 tonnes	0	Off farm (13.8)

Crops

CROP/PASTURE	AREA (HA)	YIELD	GROWN (T/DM/YR)	INTAKE (T/DM/YR)	SUPPLEMENTS (T/DM/YR)
Grass only	13.2	-	197	-	197

Fertiliser

MANUFACTURER/MATERIAL	NAME	TOTAL APPLIED (KG)	N	P	K	S	CA	MG	NA
Custom soluble fertiliser	Irrigation Pond (Fertigation)	-	4,561	286	14,296	-	-	-	-
Custom fertiliser product	Compost	500,000	1,500	500	1,000	-	-	-	-
TOTAL		**500,000**	**6,061**	**786**	**15,296**	-	-	-	-

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	3,356	5
Phosphorus	134	0.2

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	9	1	24	0	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements	0	0	0	0	0	0	0
Rain/clover fixation	2	0	4	7	5	11	65

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	5	0.2	6	7	7	11	64
As product	0	0	0	0	0	0	0

Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	1	0	0	0	0	0	0
As supplements and crop residues	6	1	6	1	1	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	0	0	0	-1	0	0	0
Inorganic mineral	0	0	0	0	0	0	0
Inorganic soil pool	0	0	15	0	-3	0	1

Blocks

Lower irrigation

Cut and carry - Flat, 8.1ha

N loss: 1435 N loss/ha: 177 P loss: 2 P loss/ha: 0.2

BLOCK DETAILS

Area	8.1 ha	Average temp	13.5° C	Average rainfall	1798 mm/yr	Annual PET	867 mm
Distance from coast	7 km						

SOILS

100% BROWN
8.1 ha

ARTIFICIAL DRAINAGE

Drainage method None

SUPPLEMENTS

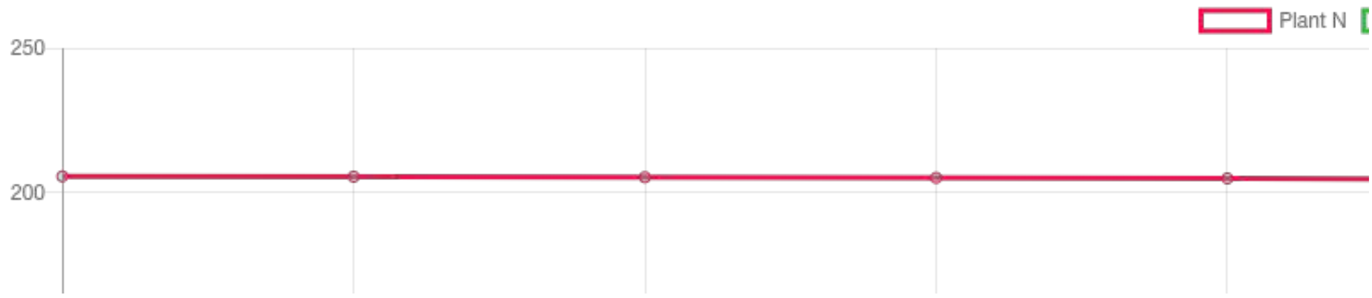
Harvested (DM) 120.5 tonnes

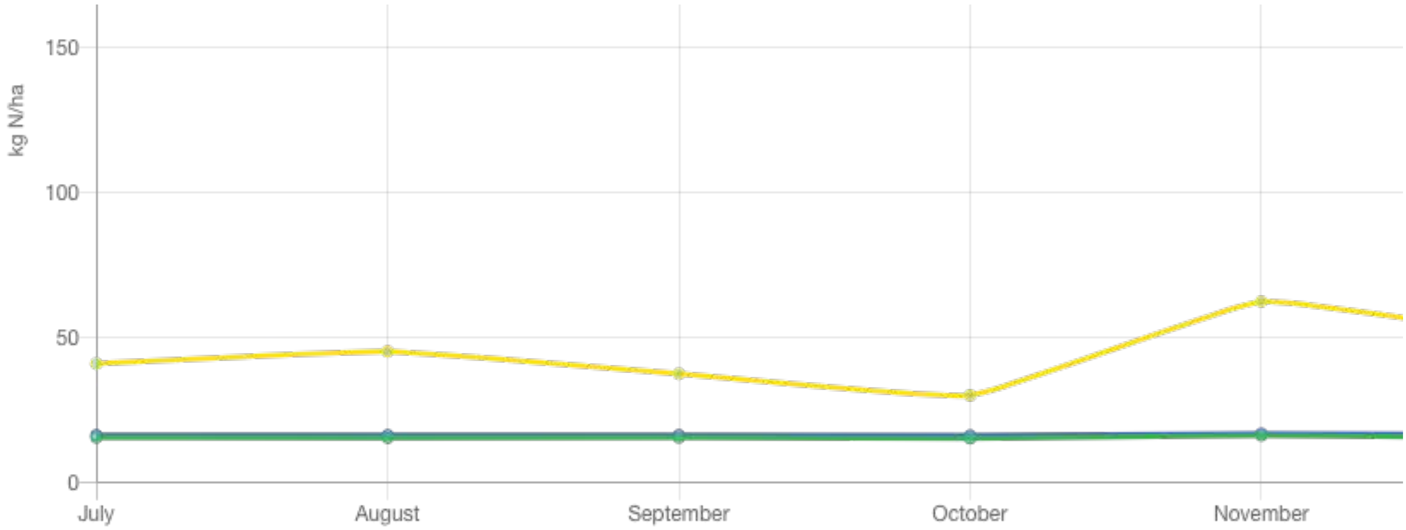
CROP MANAGEMENT

Block type	Pasture	Cultivated in last 5 years	Yes
Topography	Flat	Animals present	No
Pasture type	Grass only		

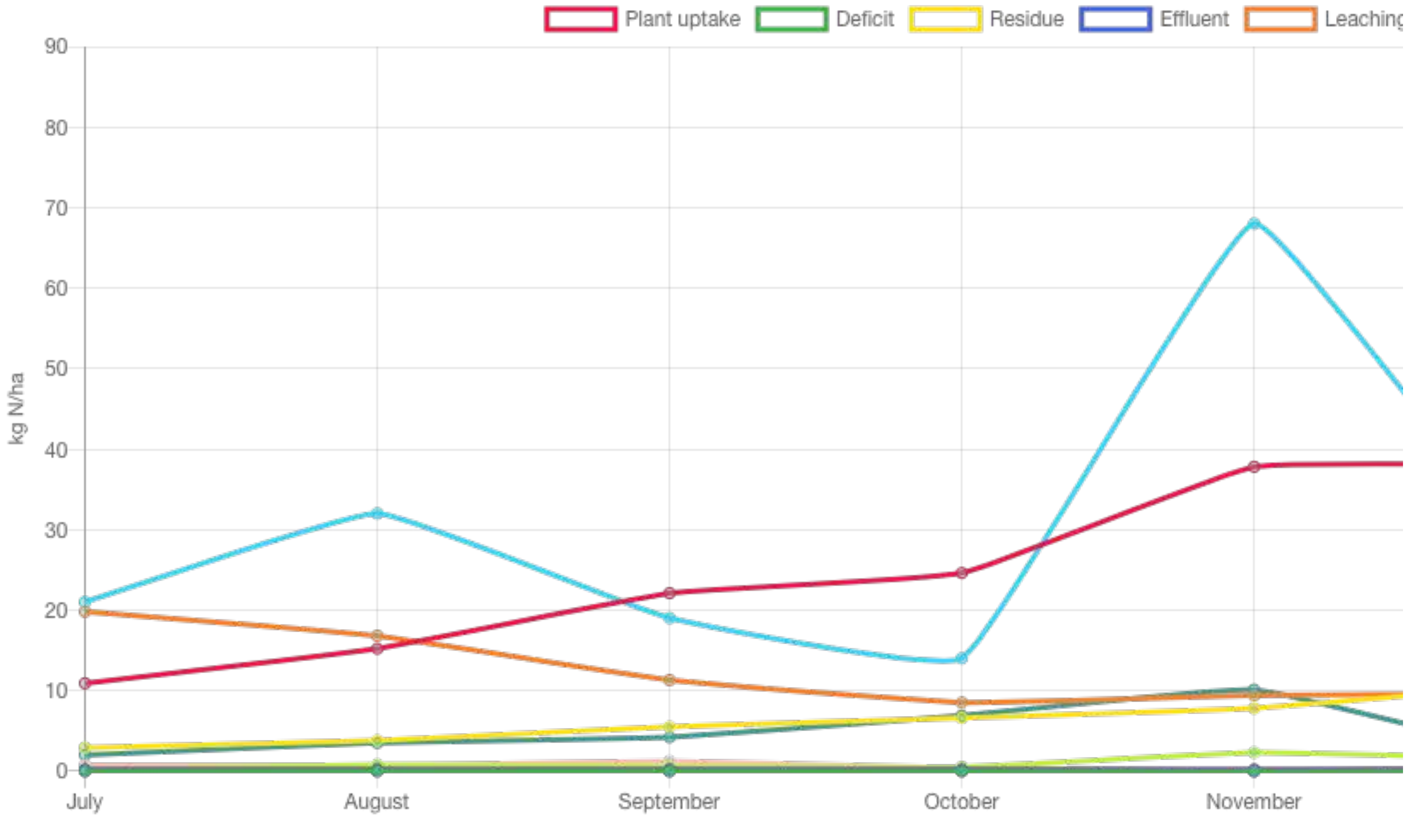
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
FERTILISER APPLIED (KG/HA)												
N	-	-	-	-	38	-	38	-	38	-	-	-
P	-	-	-	-	13	-	13	-	13	-	-	-
K	169	162	95	60	104	63	66	54	120	104	96	65
S	-	-	-	-	-	-	-	-	-	-	-	-

Nitrogen pools





Change in nitrogen pools



RESULTS BY SOIL AND IRRIGATION

				NITROGEN					PHOSPHORUS		P LOSS CATE	
SOIL	IRRIGATOR	PERCENTAGE	AREA	TOTAL LOST	LOST	DRAINAGE	SURPLUS	ADDED	TOTAL LOST	LOST	SOIL	FERTILISEF
Brown	No irrigation	100%	8.1 ha	1435 kg	177 kg/ha	16.2 ppm	216 kg/ha	460 kg/ha	2 kg	0.2 kg/ha	N/A	N/A

					TO 60CM				T	
SOIL	IRRIGATOR	PERCENTAGE	DRAINAGE	RUNOFF	FIELD CAPACITY	WILTING POINT	SATURATION	PAW	FIELD CAPACITY	WILT
Brown	No irrigation	100%	1094 mm	0 mm	69 mm	30 mm	99 mm	39 mm	-	-

MODEL NOTES

Overview

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

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

- Increase in Olsen P test of 4 units
- Increase in QT K test of 12 units
- Increase in QT Mg test of 1 units

N losses from the root zone from this block exceed 11.3 ppm. This could contribute to high drinking water levels. The drinking water standard is 11.3 ppm. Note that the drinking water standard is not a environmental water quality standard, which is usually lower than the drinking water standard or a regulatory standard.Consider mitigation options to reduce this loss

The change in inorganic soil pool indicates that fertiliser nutrients can be reduced for K

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

NUTRIENT BUDGET

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	1,435	177
Phosphorus	2	0.2

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Effluent added	0	0	0	0	0	0	0
Fertiliser, lime and other	460	59	1159	0	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements fed on blocks	0	0	0	0	0	0	0
Rain/clover fixation	23	0	4	9	7	16	96

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	177	0.2	146	12	139	6	45
To atmosphere	30	0	0	0	0	0	0
As Supplements	267	30	314	28	45	8	7

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	9	9	0	-32	0	0	0
Inorganic mineral	0	1	-3	0	-2	-3	-4
Inorganic soil pool	0	19	706	0	-176	6	49

Upper Irrigation

Cut and carry - Flat, 5.1ha

N loss: 658 N loss/ha: 129 P loss: 2 P loss/ha: 0.3

BLOCK DETAILS

Area	5.1 ha	Average temp	13.3° C	Average rainfall	1866 mm/yr	Annual PET	856 mm
Distance from coast	7 km						

SOILS

100% BROWN
5.1 ha

ARTIFICIAL DRAINAGE

Drainage method None

SUPPLEMENTS

Harvested (DM) 76.6 tonnes

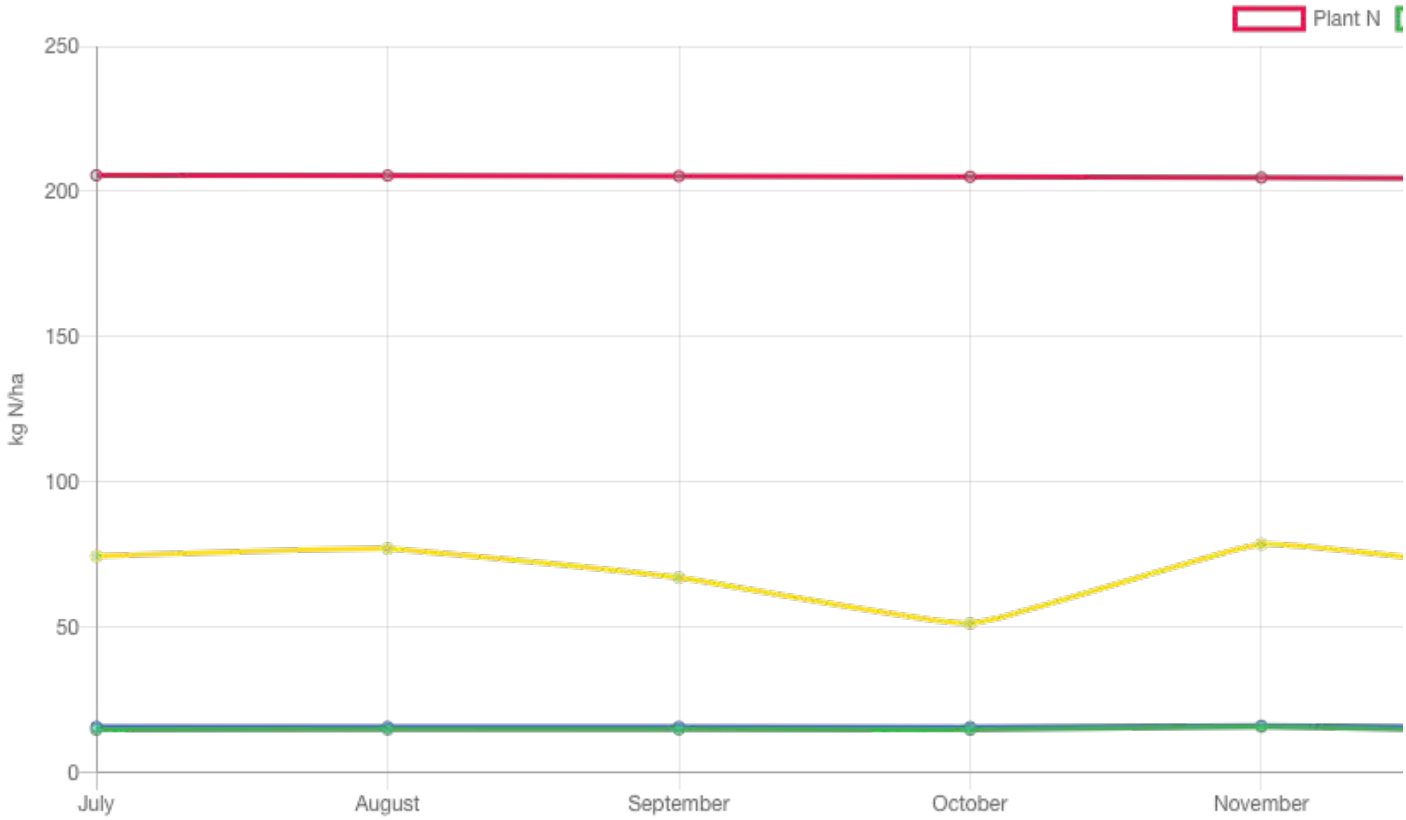
Harvested (DM) 76.6 tonnes

CROP MANAGEMENT

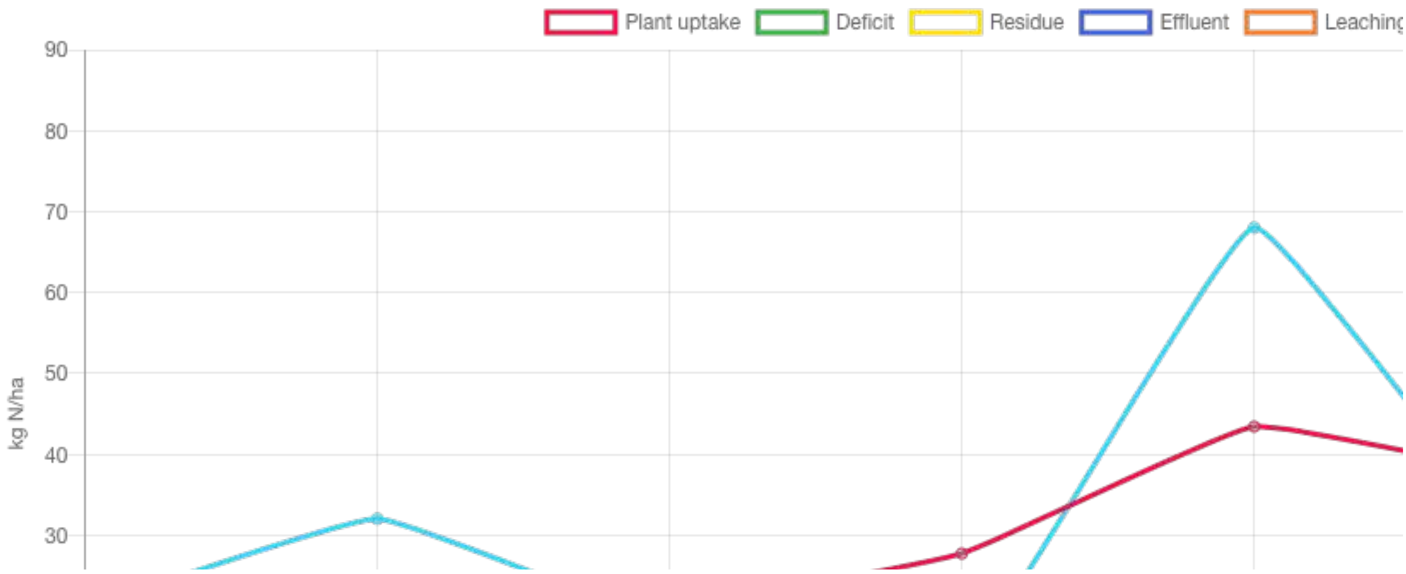
Block type	Pasture	Cultivated in last 5 years	Yes
Topography	Flat	Animals present	No
Pasture type	Grass only		

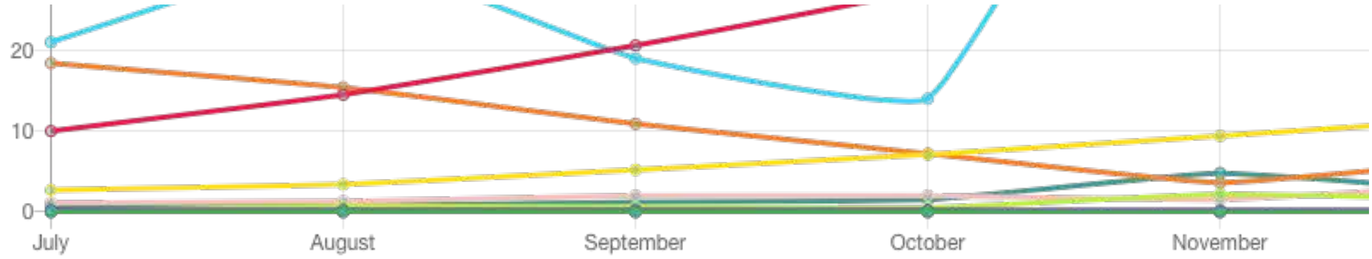
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
FERTILISER APPLIED (KG/HA)												
N	-	-	-	-	38	-	38	-	38	-	-	-
P	-	-	-	-	13	-	13	-	13	-	-	-
K	169	162	95	60	104	63	66	54	120	104	96	65
S	-	-	-	-	-	-	-	-	-	-	-	-

Nitrogen pools



Change in nitrogen pools





RESULTS BY SOIL AND IRRIGATION

				NITROGEN					PHOSPHORUS		P LOSS CATE	
SOIL	IRRIGATOR	PERCENTAGE	AREA	TOTAL LOST	LOST	DRAINAGE	SURPLUS	ADDED	TOTAL LOST	LOST	SOIL	FERTILISEF
Brown	No irrigation	100%	5.1 ha	658 kg	129 kg/ha	12 ppm	197 kg/ha	460 kg/ha	2 kg	0.3 kg/ha	N/A	N/A

					TO 60CM				T	
SOIL	IRRIGATOR	PERCENTAGE	DRAINAGE	RUNOFF	FIELD CAPACITY	WILTING POINT	SATURATION	PAW	FIELD CAPACITY	WILT
Brown	No irrigation	100%	1079 mm	0 mm	233 mm	140 mm	339 mm	93 mm	-	-

MODEL NOTES

Overview

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

- Increase in Olsen P test of 4 units
- Increase in QT K test of 12 units
- Increase in QT Mg test of 1 units

N losses from the root zone from this block exceed 11.3 ppm. This could contribute to high drinking water levels. The drinking water standard is 11.3 ppm. Note that the drinking water standard is not a environmental water quality standard, which is usually lower than the drinking water standard or a regulatory standard.Consider mitigation options to reduce this loss

The change in inorganic soil pool indicates that fertiliser nutrients can be reduced for K

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

NUTRIENT BUDGET

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	658	129
Phosphorus	2	0.3

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Effluent added	0	0	0	0	0	0	0
Fertiliser, lime and other	460	59	1159	0	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements fed on blocks	0	0	0	0	0	0	0
Rain/clover fixation	11	0	4	9	7	17	100

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	129	0.3	146	11	101	5	44
To atmosphere	46	0	0	0	0	0	0
As Supplements	274	30	317	29	46	8	7

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	22	9	0	-31	0	0	0
Inorganic mineral	0	1	-3	0	-2	-3	-4
Inorganic soil pool	0	19	702	0	-138	7	53

Appendix 5 - Overseer 2022 + 2,000m^3 compost

Uruti Composting Facility

Uruti, New Zealand

OverseerFM

2022 + compost 2000m3

Analysis type	Scenario
Is publication	No
Application version	3.1.0.3
Printed date	15 Jun, 2020, 9:20AM
Model version	6.3.3

Farm details

N: 4352 N/ha: 7 P: 135 P/ha: 0.2 GHG/ha: 195 NCE: 41% v6.3.3

Total area	641 ha
Productive block area	13.20 ha
Nitrogen conversion efficiency (NCE)	41%
N Surplus	8 kg/ha
Region	Taranaki

Blocks

NAME	TYPE	AREA (HA)	N LOSS	N LOSS/HA	N SURPLUS/HA	P LOSS	P LOSS/HA
Lower irrigation	Cut and carry	8.1	2079	257	315	2	0.3
Upper Irrigation	Cut and carry	5.1	1009	198	296	2	0.4
Other sources	Other	-	1263	-	-	130	-

Farm soils

S-MAP REF	GROUP/ORDER	DRAINAGE CLASS	MODIFIED	TOTAL AREA (HA)	% OF PROD. BLOCKS	BLOCKS
-	Sedimentary/Brown	Moderately well	Yes	8.1	61.4	1
-	Sedimentary/Brown	Poor	Yes	5.1	38.6	1

Enterprises

STOCK NUMBERS

There are no animal enterprises on this farm.

RSU

There are no animal enterprises on this farm.

Irrigators

NAME	AREA COVERED	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
TRAVELLING IRRIGATOR Irrigator 1	0 ha												

Structures

No structures exist

No structures exist.

Supplements

CATEGORY	FEED	SOURCE	DRY WEIGHT?	SOURCED	DISTRIBUTED	REMAINING	DESTINATION
Baleage	-	Lower irrigation (30.9)	Yes	30.9 tonnes	30.9 tonnes	0	Off farm (30.9)
Baleage	-	Upper Irrigation (19.6)	Yes	19.6 tonnes	19.6 tonnes	0	Off farm (19.6)
Baleage	-	Lower irrigation (40.2)	Yes	40.2 tonnes	40.2 tonnes	0	Off farm (40.2)
Baleage	-	Lower irrigation (27.8)	Yes	27.8 tonnes	27.8 tonnes	0	Off farm (27.8)
Baleage	-	Lower irrigation (21.6)	Yes	21.6 tonnes	21.6 tonnes	0	Off farm (21.6)
Baleage	-	Upper Irrigation (25.5)	Yes	25.5 tonnes	25.5 tonnes	0	Off farm (25.5)
Baleage	-	Upper Irrigation (17.7)	Yes	17.7 tonnes	17.7 tonnes	0	Off farm (17.7)
Baleage	-	Upper Irrigation (13.8)	Yes	13.8 tonnes	13.8 tonnes	0	Off farm (13.8)

Crops

CROP/PASTURE	AREA (HA)	YIELD	GROWN (T/DM/YR)	INTAKE (T/DM/YR)	SUPPLEMENTS (T/DM/YR)
Grass only	13.2	-	197	-	197

Fertiliser

MANUFACTURER/MATERIAL	NAME	TOTAL APPLIED (KG)	N	P	K	S	CA	MG	NA
Custom soluble fertiliser	Irrigation Pond (Fertigation)	-	4,561	286	14,296	-	-	-	-
Custom fertiliser product	Compost	1,000,000	3,000	1,000	2,000	-	-	-	-
TOTAL		**1,000,000**	**7,561**	**1,286**	**16,296**	-	-	-	-

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	4,352	7
Phosphorus	135	0.2

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	12	2	25	0	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements	0	0	0	0	0	0	0
Rain/clover fixation	2	0	4	7	5	11	65

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	7	0.2	7	7	8	11	64
As product	0	0	0	0	0	0	0

	N	P	K	S	CA	MG	NA
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	1	0	0	0	0	0	0
As supplements and crop residues	6	1	6	1	1	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	1	0	0	-1	0	0	0
Inorganic mineral	0	0	0	0	0	0	0
Inorganic soil pool	0	1	16	0	-5	0	1

Blocks

Lower irrigation

Cut and carry - Flat, 8.1ha

N loss: 2079 N loss/ha: 257 P loss: 2 P loss/ha: 0.3

BLOCK DETAILS

Area	8.1 ha	Average temp	13.5° C	Average rainfall	1798 mm/yr	Annual PET	867 mm
Distance from coast	7 km						

SOILS

100% BROWN
8.1 ha

ARTIFICIAL DRAINAGE

Drainage method None

SUPPLEMENTS

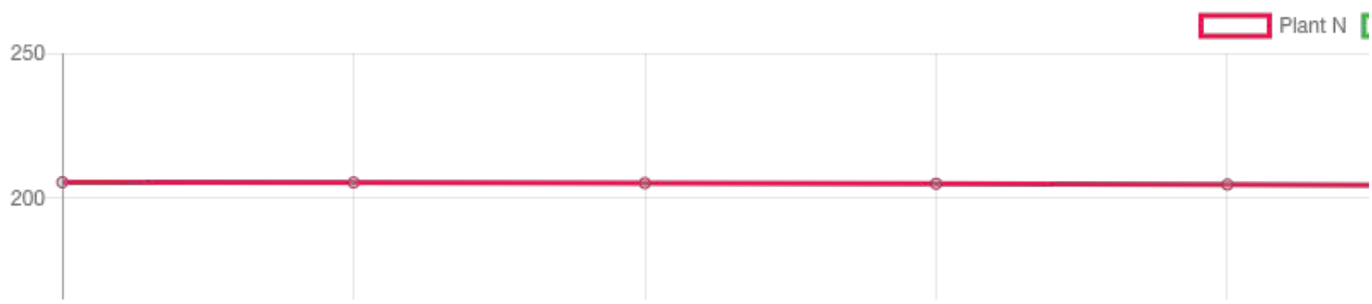
Harvested (DM) 120.5 tonnes

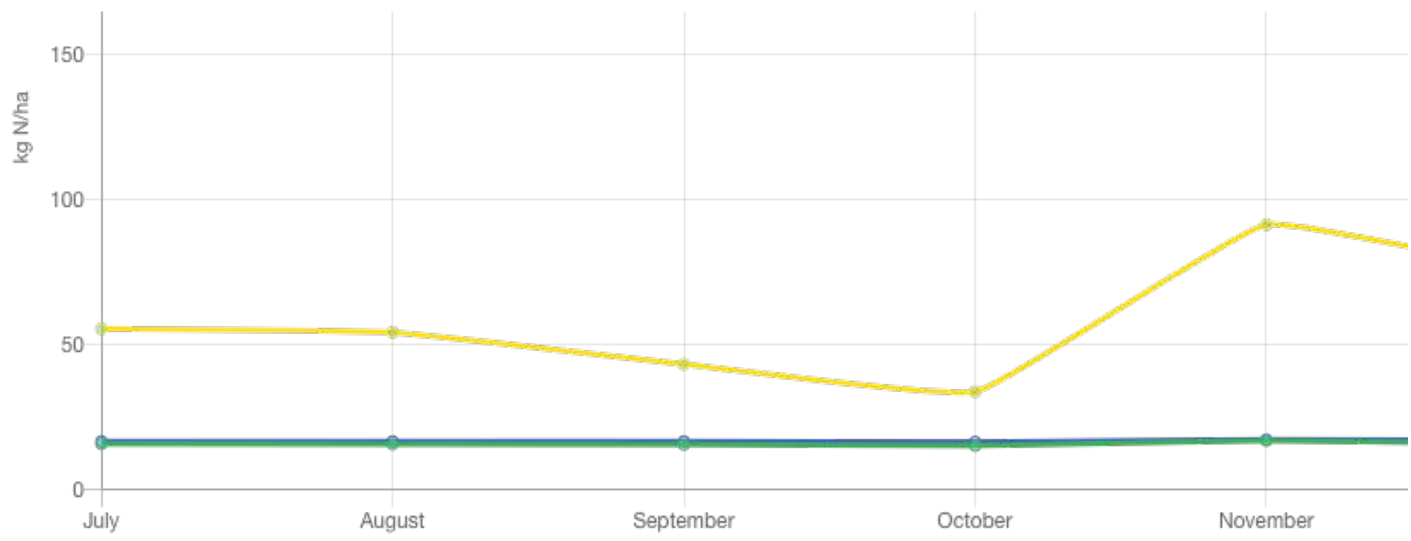
CROP MANAGEMENT

Block type	Pasture	Cultivated in last 5 years	Yes
Topography	Flat	Animals present	No
Pasture type	Grass only		

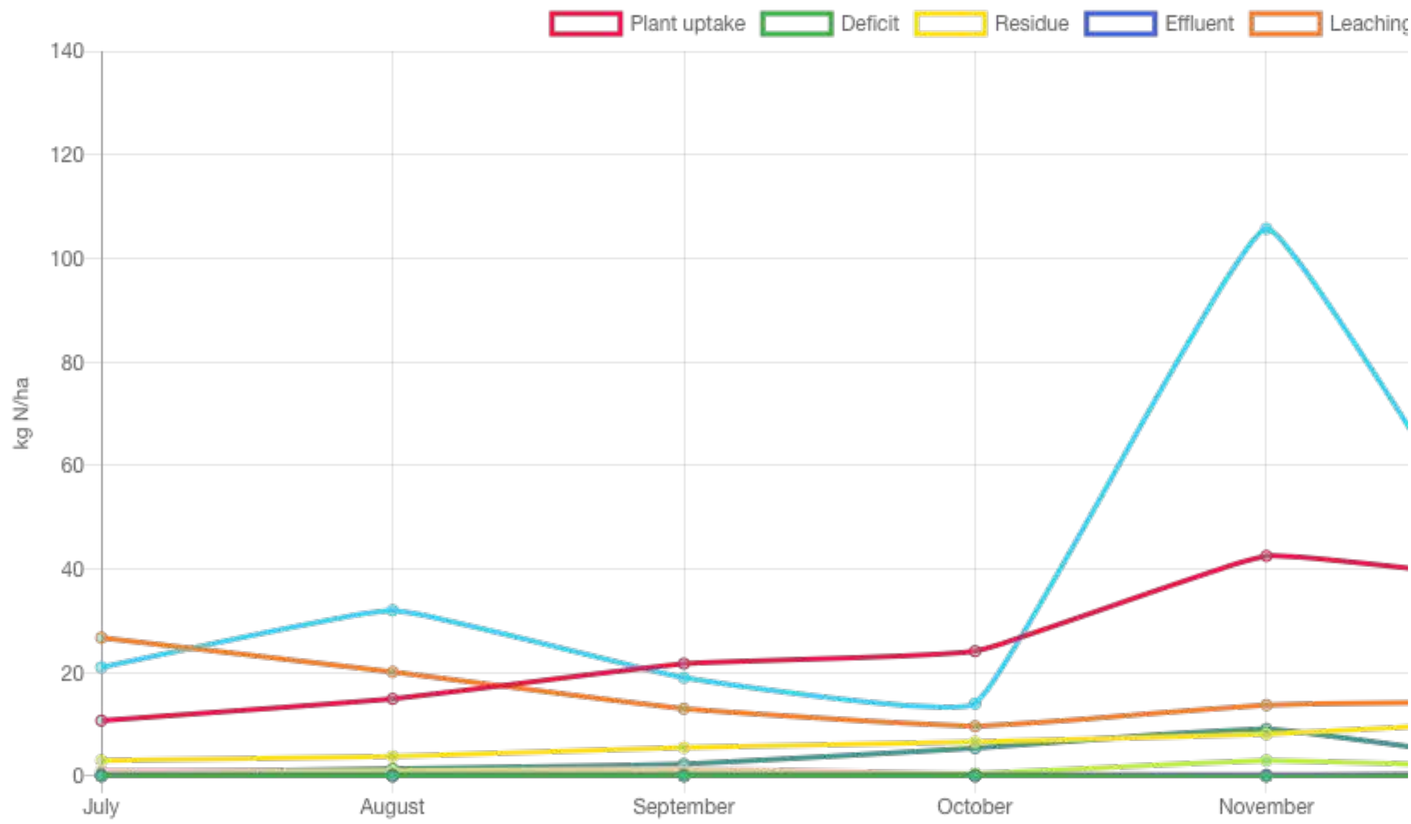
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
FERTILISER APPLIED (KG/HA)												
N	-	-	-	-	76	-	76	-	76	-	-	-
P	-	-	-	-	25	-	25	-	25	-	-	-
K	169	162	95	60	129	63	91	54	146	104	96	65
S	-	-	-	-	-	-	-	-	-	-	-	-

Nitrogen pools





Change in nitrogen pools



RESULTS BY SOIL AND IRRIGATION

				NITROGEN					PHOSPHORUS		P LOSS CATE	
SOIL	IRRIGATOR	PERCENTAGE	AREA	TOTAL LOST	LOST	DRAINAGE	SURPLUS	ADDED	TOTAL LOST	LOST	SOIL	FERTILISER
Brown	No irrigation	100%	8.1 ha	2079 kg	257 kg/ha	23.5 ppm	315 kg/ha	573 kg/ha	2 kg	0.3 kg/ha	N/A	N/A

					TO 60CM					
SOIL	IRRIGATOR	PERCENTAGE	DRAINAGE	RUNOFF	FIELD CAPACITY	WILTING POINT	SATURATION	PAW	FIELD CAPACITY	WILT
Brown	No irrigation	100%	1094 mm	0 mm	69 mm	30 mm	99 mm	39 mm	-	-

MODEL NOTES

Overview

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

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

- Increase in Olsen P test of 11 units
- Increase in QT K test of 13 units
- Increase in QT Mg test of 1 units

N losses from the root zone from this block exceed 11.3 ppm. This could contribute to high drinking water levels. The drinking water standard is 11.3 ppm. Note that the drinking water standard is not a environmental water quality standard, which is usually lower than the drinking water standard or a regulatory standard.Consider mitigation options to reduce this loss

The change in inorganic soil pool indicates that fertiliser nutrients can be reduced for P, K

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

NUTRIENT BUDGET

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	2,079	257
Phosphorus	2	0.3

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Effluent added	0	0	0	0	0	0	0
Fertiliser, lime and other	573	97	1235	0	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements fed on blocks	0	0	0	0	0	0	0
Rain/clover fixation	16	0	4	9	7	16	96

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	257	0.3	162	12	202	6	45
To atmosphere	37	0	0	0	0	0	0
As Supplements	274	32	314	28	45	7	7

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	21	9	0	-32	0	0	0
Inorganic mineral	0	1	-3	0	-2	-3	-4
Inorganic soil pool	0	55	766	0	-238	6	49

Upper Irrigation

Cut and carry - Flat, 5.1ha

N loss: 1009 N loss/ha: 198 P loss: 2 P loss/ha: 0.4

BLOCK DETAILS

Area	5.1 ha	Average temp	13.3° C	Average rainfall	1866 mm/yr	Annual PET	856 mm
Distance from coast	7 km						

SOILS

100% BROWN
5.1 ha

ARTIFICIAL DRAINAGE

Drainage method	None

SUPPLEMENTS

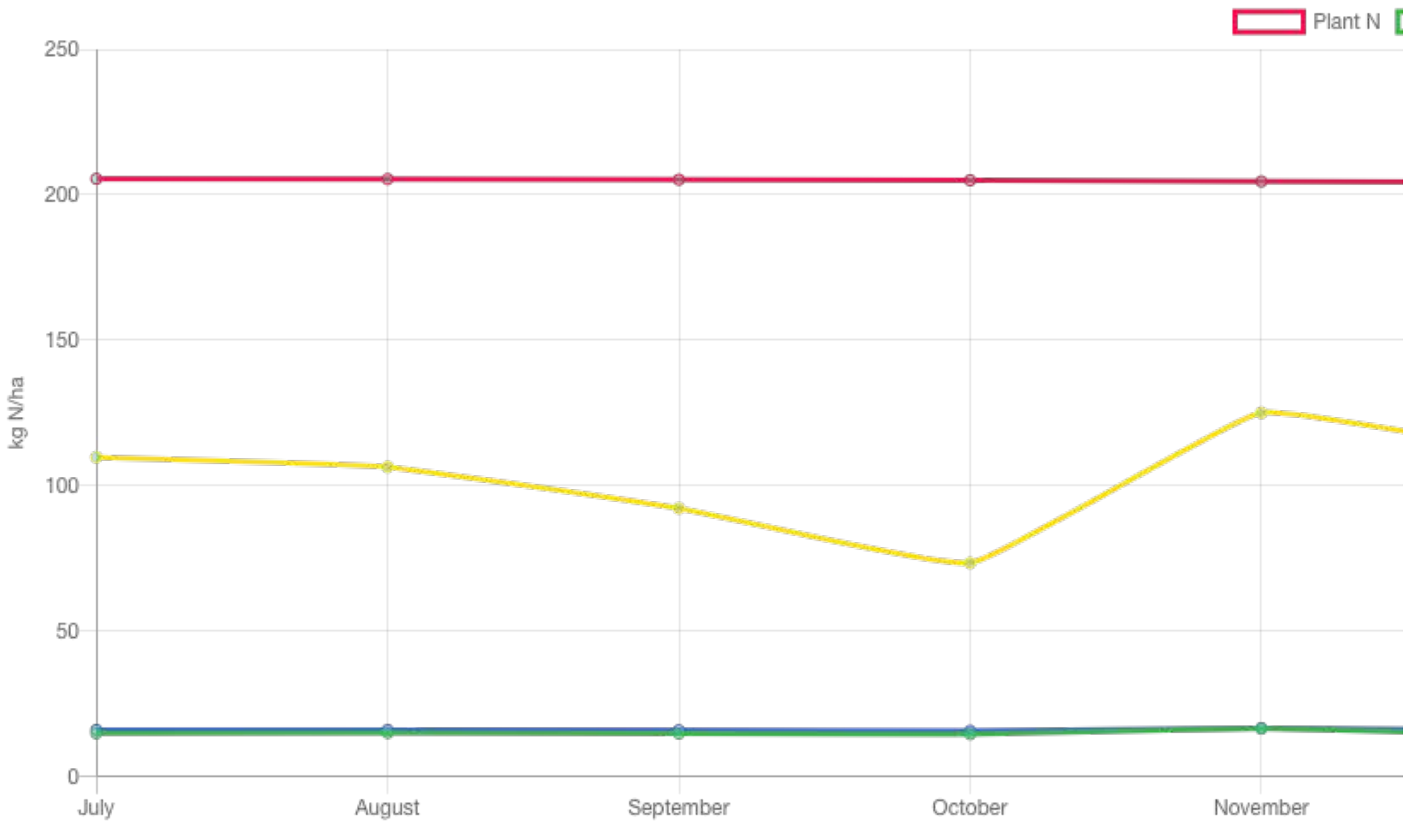
Harvested (DM) 76.6 tonnes

CROP MANAGEMENT

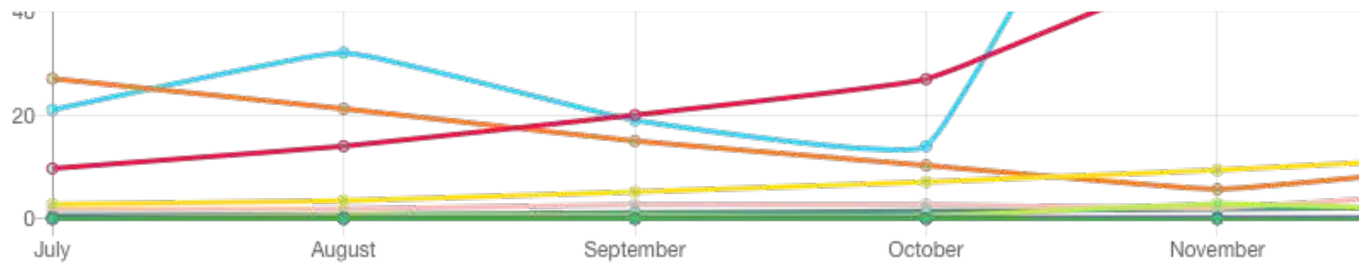
Block type	Pasture	Cultivated in last 5 years	Yes
Topography	Flat	Animals present	No
Pasture type	Grass only		

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
FERTILISER APPLIED (KG/HA)												
N	-	-	-	-	76	-	76	-	76	-	-	-
P	-	-	-	-	25	-	25	-	25	-	-	-
K	169	162	95	60	129	63	91	54	146	104	96	65
S	-	-	-	-	-	-	-	-	-	-	-	-

Nitrogen pools



Change in nitrogen pools



RESULTS BY SOIL AND IRRIGATION

				NITROGEN					PHOSPHORUS		P LOSS CATE	
SOIL	IRRIGATOR	PERCENTAGE	AREA	TOTAL LOST	LOST	DRAINAGE	SURPLUS	ADDED	TOTAL LOST	LOST	SOIL	FERTILISE
Brown	No irrigation	100%	5.1 ha	1009 kg	198 kg/ha	18.3 ppm	296 kg/ha	573 kg/ha	2 kg	0.4 kg/ha	N/A	N/A

					TO 60CM				T	
SOIL	IRRIGATOR	PERCENTAGE	DRAINAGE	RUNOFF	FIELD CAPACITY	WILTING POINT	SATURATION	PAW	FIELD CAPACITY	WILT
Brown	No irrigation	100%	1079 mm	0 mm	233 mm	140 mm	339 mm	93 mm	-	-

MODEL NOTES

Overview

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

- Increase in Olsen P test of 11 units
- Increase in QT K test of 13 units
- Increase in QT Mg test of 1 units

N losses from the root zone from this block exceed 11.3 ppm. This could contribute to high drinking water levels. The drinking water standard is 11.3 ppm. Note that the drinking water standard is not a environmental water quality standard, which is usually lower than the drinking water standard or a regulatory standard.Consider mitigation options to reduce this loss

The change in inorganic soil pool indicates that fertiliser nutrients can be reduced for P, K

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

NUTRIENT BUDGET

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	1,009	198
Phosphorus	2	0.4

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Effluent added	0	0	0	0	0	0	0
Fertiliser, lime and other	573	97	1235	0	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements fed on blocks	0	0	0	0	0	0	0
Rain/clover fixation	4	0	4	9	7	17	100

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	198	0.4	162	11	156	5	44
To atmosphere	64	0	0	0	0	0	0
As Supplements	282	32	317	29	46	8	7

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	34	9	0	-31	0	0	0
Inorganic mineral	0	1	-3	0	-2	-3	-4
Inorganic soil pool	0	55	762	0	-192	7	53