Arawhata Farm Soil Sampling

March 2023

horizons
REGIONAL COUNCIL

Prepared for:

Logan Brown
Freshwater and Partnerships Manager

March 2023

Prepared by:
Lowe Environmental Impact
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MEMORANDUM **Job 10682**

To:	Charlotte Minnis (Horizons Regional Council)
From:	Katie Beecroft & Eise Venter (Lowe Environmental Impact)
Date:	9 March 2023 (updated)
Subject:	HRC – Arawhata Farm Soil Sampling

PURPOSE

The purpose of this memo is to a summary following soil core sampling undertaken on the 13th and 14th of December 2022 at Arawhata farm located near Lake Horowhenua.

BACKGROUND

Horizons Regional Council (HRC) has engaged Lowe Environmental Impact (LEI) to undertake soil sampling within the high nutrient status Lake Horowhenua catchment. Soil sampling consists of the taking of soil core samples at twelve locations on the Arawhata farm, up to a depth of 3 m or until groundwater is encountered (whichever is first). The topography of the Arawhata farm is reflected by a slightly higher elevation in the south western part of the farm, gradually becoming lower towards the north eastern part of the farm near Lake Horowhenua.

OBJECTIVES

The objectives for the sampling were as follows:

- Obtain representative soil core samples from twelve proposed locations as per depth specifications provided by HRC;
- Provide a brief description of cores by depth; and
- Submit the samples to Hill Laboratories for analysis.

SAMPLING EQUIPMENT

The sampling equipment used for undertaking the soil sampling is detailed in Table 1.

Table 1: Soil Sampling Equipment

Field sheets and pen
Map indication sampling locations
Hand-held field GPS
Mobile phone with camera
Hand auger with Dutch auger head and extensions
Spade
Hand trowel
Measuring tape
Dipmeter
Tarpaulin
Snap lock sampling bags
Black permanent marker

Chilly Bin
Slickers / ice packs
Hand brush
1 x 20 L container of water
Sample analysis form

SAMPLING METHODOLOGY

The depth to which soil cores were taken was determined by the surface elevation and corresponding depth at which groundwater was encountered, with cores to be taken to a maximum depth of 3 m. The depth to which soil cores were taken at a specific sampling location then determined at which depth intervals representative soil sub-samples were to be taken for laboratory analysis, as follow:

Core Depth	Sampling Intervals (m)		
Lower elevations (0 - 2 m)	0 - 0.5	0.5 - 1	1 - 2
Higher elevations (0 - 3 m)	0 - 0.5	0.5 - 1.5	1.5 - 3

The method used to collect soil samples is summarised as follow:

1. Locate the applicable monitoring location.
2. Record the location with a hand-held field GPS.
3. Take photos of the general sampling location.
4. Record the vegetation cover.
5. Place a clean tarpaulin on the ground next to the sampling location.
6. Use a hand auger with Dutch auger head to remove the soil core one auger volume at a time. Each auger volume should be removed from the auger head by laying down the auger head horizontally at the correct location on the tarpaulin and removing the content with a hand trowel.
7. The removed soil core should be laid on the tarpaulin in separate rows of 0.5 m depth, in sequence as removed from top to bottom, left to right. Use auger extensions pre-marked with insulation tape to determine 0.5 m auger depth intervals.
8. Record the soil type and composition of each 0.5 m depth immediately after being removed, as it is easier to accurately determine the soil colour when moist/wet. Use the measuring tape to record the depth of each soil horizon encountered.
9. Continue to remove soil core until groundwater is encountered or to a maximum depth of 3 m.
10. If applicable, use a dipmeter (contact probe) to determine the groundwater level as measure from the ground surface level, and record on the field sheet.
11. The depth intervals from which soil sub-samples will be taken (see table above) is informed by the depth to which core was removed. Record the depth intervals in the provided fields on the field sheet.
12. Label the respective snap lock bags with applicable monitoring location and sampling depth interval.
13. Use the hand trowel to place approximately 1 kg of well representative soil from each sampling depth interval into the applicable snap lock bag.
14. Place the snap lock bag in a chilly bin with ice packs.
15. Measure the depth to groundwater again and record any changes observed (the groundwater level at several locations rose over time).

16. Discard any leftover soil back into the auger hole.
17. Clean the tarpaulin with a hand brush and clean water.
18. Wash the auger head, auger extensions, hand trowel and hand brush with clean water.
19. Proceed to the next sampling location.
20. Repeat steps 1 through to 19 until all locations have been sampled.

SAMPLING LOCATIONS

The location description and coordinates (WGS84) of the respective sampling location are detailed in Table 2. A map illustrating the sampling locations are provided in Figure 1, with photos of each sampling location provided in Figure 2 to Figure 13.

Table 2: Sampling Location Information

ID	Location Description	Coordinates - WGS84	
		Latitude	Longitude
A1	Top site	-40.639971	175.227497
A2	Hay shed	-40.638136	175.229009
A3	Joblins above	-40.638047	175.232049
A4	Buried drain	-40.634696	175.232617
A5-2	Joblins	-40.633757	175.236255
A6	Joblins below	-40.630974	175.237900
A7	Bund end	-40.628837	175.237269
A8	Milking shed	-40.627125	175.242472
A9	Ferry side	-40.622826	175.240085
A10	Pump shed	-40.623469	175.242491
A11	Hokio Beach Rd	-40.623470	175.245053
A12	Makomako	-40.619967	175.251203

Figure 1: Map of Sampling Locations

Figure 2: Sampling Location A1

Figure 3: Sampling Location A2

Figure 4: Sampling Location A3

Figure 5: Sampling Location A4

Figure 6: Sampling Location A5-2

Figure 7: Sampling Location A6

Figure 8: Sampling Location A7

Figure 9: Sampling Location A8

Figure 10: Sampling Location A9

Figure 11: Sampling Location A10

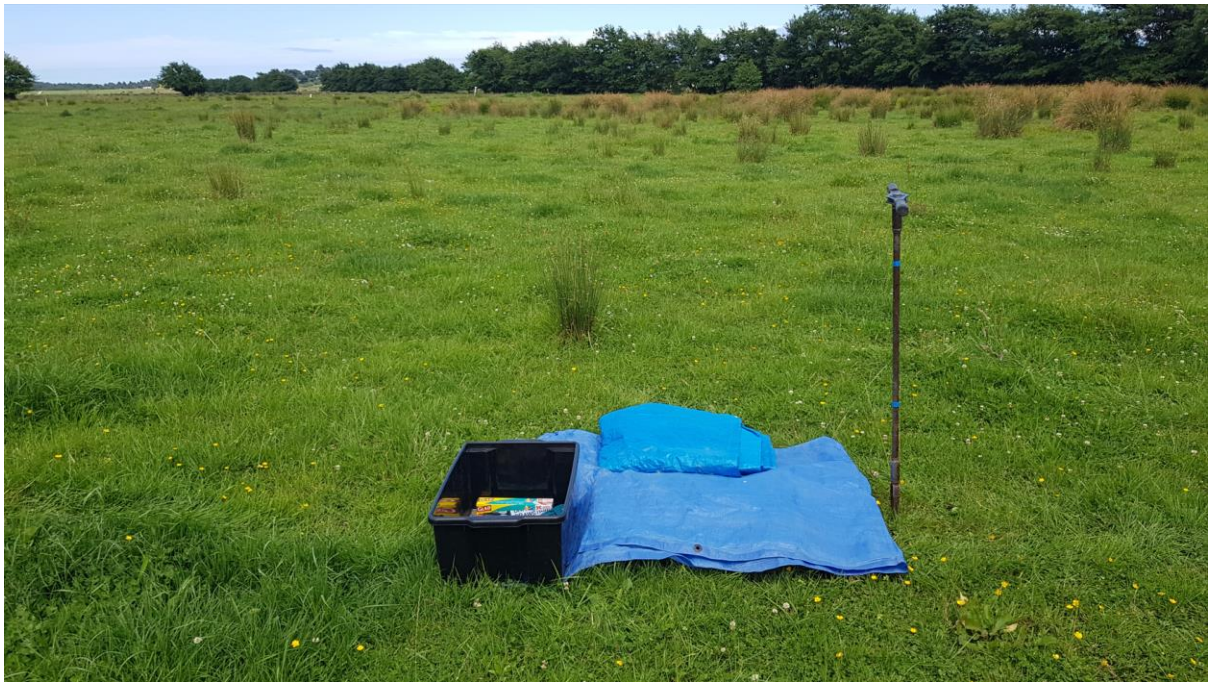

Figure 12: Sampling Location A11

Figure 13: Sampling Location A12

FIELD OBSERVATIONS

Field observation results are summarised in Table 3, with additional feedback provided in the section below.

Table 3: Field Observations Summary

ID	Location Description	Vegetation Cover	Auger/Hole Depth (mbgl)	Wet/Saturated Soil Encountered at Depth (mbgl)	Groundwater Level (mbgl)
A1	Top site	Pasture, Scotch thistle	3.00	Not reached	Not reached
A2	Hay shed	Pasture	2.00	1.85 - 2.00	2.00
A3	Joblins above	Pasture	1.50	1.50 +	1.35
A4	Buried drain	Pasture	0.80	0.80 - 1.00	0.55
A5-2	Joblins	Pasture	1.30	Not reached	Not reached
A6	Joblins below	Pasture	1.33	Not reached	Not reached
A7	Bund end	Pasture	1.00	0.70 - 1.00	0.65
A8	Milking shed	Pasture	1.32	1.25 - 1.32	1.30
A9	Ferry side	Pasture	0.70	0.60 - 0.70	0.71
A10	Pump shed	Pasture	0.70	Moist up to 0.70	0.66
A11	Hokio Beach Rd	Pasture	1.30	1.05 - 1.30	0.58
A12	Makomako	Pasture	1.20	Not reached	Not reached

mbgl - meter below ground level

Groundwater Levels

Groundwater levels at monitoring locations A3, A4, A7, A10 and A11 were observed to have risen above the level at which wet or saturated soil was encountered. The rise in water level over time was particularly evident at A4 and A11.

Sampling Locations A5, A5-2 and A6

At A5 it was only possible to auger to a depth of 1.10 m after which gravel was encountered. On the following day an alternative sampling location A5-2 was identified approximately 15 m to the north east from A5. Here it was possible to auger to a depth of 1.30 m before gravel was once again encountered. As deeper progress was made it was decided to take soil core samples at A5-2, even though no groundwater was encountered. At A-6 it was possible to auger to a depth of 1.33 m before gravel was encountered. With the observations made at A5 and A5-2 and due to a time constraint, it was decided take samples at A6 even though groundwater was not encountered.

Sampling Location A12

A12 constituted a sandy gravel from a depth of 0.26 m. Soil core could therefore not be removed with a hand auger. A hole measuring approximately 0.2 x 0.2 m was then hand dug with a spade. The hole was dug to a depth of 1.2 m after which the attempt to reach groundwater was abandoned. Samples were obtained from A12.

SAMPLING HANDLING

All samples were kept in a chilly bin with ice packs during the days when sampling was undertaken. On the respective evenings of 13 and 14 December 2022 following sampling the samples were transferred to and kept in a refrigerator. On the afternoon of 15 December 2022, the samples were placed in a chilly bins with ice packs and couriered overnight to Hill Laboratories, to arrive on the morning of 16 December.

Sample submission forms/analysis request forms were submitted with the samples in the chilly bins indication analysis requirements. Forms were placed within snap lock bags to keep them dry.

SAMPLE ANALYSIS

Samples were sent to Hill Laboratories for accredited analysis and were analysed for the following parameters:

- Soil texture
- Volume weight
- Soil pH
- Cation exchange capacity
- Total N and P
- Soil organic matter
- Total organic carbon
- Salinity/salt content (ECse)
- Extractable nutrients
- Extractable metals (Mehlich 3 profile)

LABORATORY TEST RESULTS

A total of thirty two soil core samples were taken Arawhata Farm, with a summary of the respective sampling depth intervals provided in Table 4. Corresponding laboratory test results received are included in Appendix A.

Table 4: Soil Samples Summary

ID	Auger/Hole Depth	Lower Elevations: 0 - 2 mbgl			Deeper Elevations: 0 - 3 mbgl		
		0 - 0.5	0.5 - 1	1 - 2	0 - 0.5	0.5 - 1.5	1.5 - 3
	mbgl						
A1	3.00	-	-	-	A	B	C
A2	2.00	A	B	C	-	-	-
A3	1.50	A	B	C	-	-	-
A4	0.80	A	B[1]	-	-	-	-
A5-2	1.30	A	B	C	-	-	-
A6	1.33	A	B	C	-	-	-
A7	1.00	A	B	-	-	-	-
A8	1.32	A	B	C	-	-	-
A9	0.70	A	B[1, 3]	-	-	-	-
A10	0.70	A	B[1]	-	-	-	-
A11	1.30	A	B	C	-	-	-
A12	1.20	A	B[2]	C	-	-	-

mbgl - meter below ground level

[1] Insufficient sample volume to analyse for Soil Organic Matter

[2] Insufficient sample volume (due to high gravel content) to analyse for Soil Organic Matter

[3] Unable to perform Soil Texture analysis due to high organic matter content in sample

A spreadsheet of results from Hill Laboratories is included in the reporting package for ease of use by Horizons and their advisors.

If you have any questions, please do not hesitate to get in contact.

Yours sincerely,

Lowe Environmental Impact

Katie Beecroft / Eise Venter
katie@lei.co.nz / eise@lei.co.nz

APPENDIX A

Laboratory Test Results

Hill Laboratories
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R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

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Certificate of Analysis

Client:	Lowe Environmental Impact Limited	**Lab No:**	3140507 svgpv1
Address:	PO Box 4667 Palmerston North 4442	**Date Received:**	19-Dec-2022
		Date Reported:	16-Jan-2023
		Quote No:	120495
		Order No:	
		Client Reference:	
Phone:	06 359 3099	**Submitted By:**	Katie Beecroft

Soil Analysis Results

Sample Name:		A1 - A	A1 - B	A1 - C	A2 - A	A2 - B	A2 - C
Lab Number:		3140507.1	3140507.2	3140507.3	3140507.4	3140507.5	3140507.6
Sample Type:		SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor
Sample Type Code:		S10	S10	S10	S10	S10	S10
pH	pH Units	5.8	6.2	6.2	5.8	6.5	6.6
Olsen Phosphorus	mg/L	44	10	4	45	3	7
Potassium	me/100g	0.33	0.23	0.18	0.28	0.11	0.15
Potassium	%BS	2.2	2.3	7.3	2.2	0.9	2.8
Potassium	MAF units	6	5	5	6	3	4
Calcium	me/100g	4.9	3.9	0.7	5.8	4.6	1.8
Calcium	%BS	33	39	26	45	37	34
Calcium	MAF units	6	5	1	7	7	3
Magnesium	me/100g	0.76	1.40	0.37	1.54	5.22	1.97
Magnesium	%BS	5.2	14.0	14.4	11.9	42.5	37.6
Magnesium	MAF units	16	33	11	34	135	59
Sodium	me/100g	0.16	0.17	0.06	0.20	0.37	0.15
Sodium	%BS	1.1	1.7	2.3	1.6	3.0	2.9
Sodium	MAF units	7	8	4	9	20	9
CEC	me/100g	15	10	3	13	12	5
Total Base Saturation	%	42	57	50	60	84	77
Volume Weight	g/mL	0.95	1.05	1.32	0.98	1.15	1.34
Soluble Salts (Field)	%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
EC (in 1:5 Extract)	mS/cm	< 0.01	< 0.01	< 0.01	0.01	0.01	< 0.01
Organic Matter (LOI)*	g/100g dry wt	8.4	3.4	2.0	6.2	3.5	2.2
Total Nitrogen	%	0.27	0.06	< 0.04	0.19	< 0.04	< 0.04
Total Organic Carbon*	g/100g dry wt	2.7	0.49	0.10	2.1	0.27	0.07
Phosphorus (Mehlich 3)*	mg/L	40	14	21	77	1	18
Potassium (Mehlich 3)*	mg/L	98	83	83	89	67	72
Calcium (Mehlich 3)*	mg/L	814	771	177	1,020	967	453
Magnesium (Mehlich 3)*	mg/L	76.3	173.5	63.3	175.4	702	295
Sodium (Mehlich 3)*	mg/L	30	40	20	44	99	46
Sulphur (Mehlich 3)*	mg/L	19	20	18	19	37	24

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Phone:	06 359 3099	**Submitted By:**	Katie Beecroft

Soil Analysis Results

Sample Name:		A1 - A	A1 - B	A1 - C	A2 - A	A2 - B	A2 - C
Lab Number:		3140507.1	3140507.2	3140507.3	3140507.4	3140507.5	3140507.6
Sample Type:		SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor
Sample Type Code:		S10	S10	S10	S10	S10	S10
Iron (Mehlich 3)*	mg/L	99	164	79	227	203	188
Manganese (Mehlich 3)*	mg/L	18.9	11.4	2.9	53.7	4.5	8.1
Zinc (Mehlich 3)*	mg/L	0.9	< 0.5	< 0.5	2.0	0.6	< 0.5
Copper (Mehlich 3)*	mg/L	1.1	0.9	0.5	1.3	1.0	0.8
Boron (Mehlich 3)*	mg/L	0.38	0.25	0.30	0.37	0.29	0.21
Cobalt (Mehlich 3)*	mg/L	0.1	0.2	0.1	0.3	0.2	0.4
Aluminium (Mehlich 3)*	mg/L	1,550	1,458	1,597	991	1,173	1,084
'Total' Phosphorus	mg/kg	1,174	295	130	661	73	148
Sand (0.06-2mm)*	%	24	16	84	18	13	76
Silt (0.002-0.06mm)*	%	59	65	12	56	59	19
Clay (<0.002mm)*	%	17	19	4	26	27	5

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		Client Reference:	
Phone:	06 359 3099	**Submitted By:**	Katie Beecroft

Soil Analysis Results

Sample Name:		A3 - A	A3 - B	A3 - C	A4 - A	A4 - B	A5 - 2A
Lab Number:		3140507.7	3140507.8	3140507.9	3140507.10	3140507.11	3140507.12
Sample Type:		SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor
Sample Type Code:		S10	S10	S10	S10	S10	S10
pH	pH Units	5.5	5.9	6.3	5.3	5.8	6.0
Olsen Phosphorus	mg/L	26	3	9	41	27	11
Potassium	me/100g	0.18	0.10	0.12	0.32	0.23	0.34
Potassium	%BS	1.7	1.2	2.3	1.2	2.0	2.9
Potassium	MAF units	4	3	3	5	5	8
Calcium	me/100g	4.0	1.9	1.4	6.8	4.0	6.6
Calcium	%BS	38	23	28	26	35	56
Calcium	MAF units	6	3	2	7	5	9
Magnesium	me/100g	0.71	3.05	2.21	1.85	2.08	1.45
Magnesium	%BS	6.8	37.3	42.4	7.1	18.1	12.3
Magnesium	MAF units	18	87	63	33	50	35
Sodium	me/100g	0.13	0.16	0.12	0.44	0.34	0.16
Sodium	%BS	1.2	1.9	2.3	1.7	2.9	1.3
Sodium	MAF units	6	9	7	16	17	8
CEC	me/100g	11	8	5	26	12	12
Total Base Saturation	%	48	63	75	36	58	72
Volume Weight	g/mL	1.12	1.27	1.27	0.79	1.06	1.07
Soluble Salts (Field)	%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
EC (in 1:5 Extract)	mS/cm	< 0.01	< 0.01	< 0.01	0.07	0.01	< 0.01
Organic Matter (LOI)*	g/100g dry wt	5.2	2.5	2.0	23.3	-	4.1
Total Nitrogen	%	0.16	< 0.04	< 0.04	0.56	0.08	0.12
Total Organic Carbon*	g/100g dry wt	1.65	0.14	0.06	11.0	1.32	1.22
Phosphorus (Mehlich 3)*	mg/L	48	4	11	30	56	16
Potassium (Mehlich 3)*	mg/L	71	44	55	81	87	125
Calcium (Mehlich 3)*	mg/L	821	426	350	966	784	1,221
Magnesium (Mehlich 3)*	mg/L	96.1	406	311	160.0	254	171.5
Sodium (Mehlich 3)*	mg/L	32	41	30	71	77	35
Sulphur (Mehlich 3)*	mg/L	21	18	16	45	33	11
Iron (Mehlich 3)*	mg/L	330	232	203	491	422	237
Manganese (Mehlich 3)*	mg/L	17.9	3.4	10.2	10.6	11.3	20.3

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Phone:	06 359 3099	**Submitted By:**	Katie Beecroft	

Soil Analysis Results

Sample Name:		A3 - A	A3 - B	A3 - C	A4 - A	A4 - B	A5 - 2A
Lab Number:		3140507.7	3140507.8	3140507.9	3140507.10	3140507.11	3140507.12
Sample Type:		SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor
Sample Type Code:		S10	S10	S10	S10	S10	S10
Zinc (Mehlich 3)*	mg/L	1.0	< 0.5	< 0.5	2.2	1.1	0.9
Copper (Mehlich 3)*	mg/L	0.8	0.4	0.5	2.4	2.1	1.0
Boron (Mehlich 3)*	mg/L	0.30	0.22	0.16	0.30	0.19	0.30
Cobalt (Mehlich 3)*	mg/L	0.1	0.2	0.5	0.2	0.1	0.3
Aluminium (Mehlich 3)*	mg/L	1,049	936	740	1,138	1,256	734
'Total' Phosphorus	mg/kg	426	96	165	920	348	349
Sand (0.06-2mm)*	%	13	64	87	15	9	10
Silt (0.002-0.06mm)*	%	60	22	7	50	62	62
Clay (<0.002mm)*	%	27	14	6	35	29	29

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Phone:	06 359 3099	**Submitted By:**	Katie Beecroft

Soil Analysis Results

Sample Name:		A5 - 2B	A5 - 2C	A6 - A	A6 - B	A6 - C	A7 - A
Lab Number:		3140507.13	3140507.14	3140507.15	3140507.16	3140507.17	3140507.18
Sample Type:		SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor
Sample Type Code:		S10	S10	S10	S10	S10	S10
pH	pH Units	6.5	6.6	5.7	5.6	5.7	5.2
Olsen Phosphorus	mg/L	3	6	29	6	11	26
Potassium	me/100g	0.12	0.09	0.76	0.28	0.22	0.55
Potassium	%BS	1.6	1.6	5.1	2.7	1.9	2.0
Potassium	MAF units	3	2	15	7	5	9
Calcium	me/100g	3.6	2.2	6.5	3.7	4.1	7.8
Calcium	%BS	45	39	44	36	36	29
Calcium	MAF units	6	4	8	5	6	8
Magnesium	me/100g	2.81	2.25	2.41	2.94	3.91	1.95
Magnesium	%BS	35.5	39.1	16.1	28.3	34.5	7.3
Magnesium	MAF units	82	67	53	78	101	34
Sodium	me/100g	0.14	0.12	0.16	0.23	0.30	0.27
Sodium	%BS	1.8	2.0	1.1	2.2	2.6	1.0
Sodium	MAF units	9	7	7	13	16	10
CEC	me/100g	8	6	15	10	11	27
Total Base Saturation	%	84	82	66	69	75	39
Volume Weight	g/mL	1.30	1.32	0.97	1.18	1.14	0.78
Soluble Salts (Field)	%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
EC (in 1:5 Extract)	mS/cm	< 0.01	< 0.01	0.03	0.03	0.04	0.05
Organic Matter (LOI)*	g/100g dry wt	2.5	1.9	10.0	2.8	3.1	15.6
Total Nitrogen	%	< 0.04	< 0.04	0.25	< 0.04	< 0.04	0.62
Total Organic Carbon*	g/100g dry wt	0.18	0.13	3.7	0.33	0.19	8.4
Phosphorus (Mehlich 3)*	mg/L	1	7	47	7	9	37
Potassium (Mehlich 3)*	mg/L	62	42	272	123	89	138
Calcium (Mehlich 3)*	mg/L	891	522	1,195	834	870	1,047
Magnesium (Mehlich 3)*	mg/L	421	304	278	406	520	160.9
Sodium (Mehlich 3)*	mg/L	43	33	36	61	75	42
Sulphur (Mehlich 3)*	mg/L	17	13	28	53	60	23
Iron (Mehlich 3)*	mg/L	160	178	393	278	236	454
Manganese (Mehlich 3)*	mg/L	6.4	16.2	6.6	2.3	5.5	18.4

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Certificate of Analysis

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		Date Reported:	16-Jan-2023
		Quote No:	120495
		Order No:	
		Client Reference:	
Phone:	06 359 3099	**Submitted By:**	Katie Beecroft

Soil Analysis Results

Sample Name:		A5 - 2B	A5 - 2C	A6 - A	A6 - B	A6 - C	A7 - A
Lab Number:		3140507.13	3140507.14	3140507.15	3140507.16	3140507.17	3140507.18
Sample Type:		SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor
Sample Type Code:		S10	S10	S10	S10	S10	S10
Zinc (Mehlich 3)*	mg/L	0.8	0.7	4.1	1.1	0.9	5.0
Copper (Mehlich 3)*	mg/L	1.3	0.7	2.1	1.5	1.1	1.7
Boron (Mehlich 3)*	mg/L	< 0.15	< 0.15	0.36	< 0.15	< 0.15	0.32
Cobalt (Mehlich 3)*	mg/L	0.6	0.9	0.4	0.3	0.4	0.2
Aluminium (Mehlich 3)*	mg/L	733	655	853	880	865	1,067
'Total' Phosphorus	mg/kg	75	154	445	67	220	1,169
Sand (0.06-2mm)*	%	39	85	8	9	33	13
Silt (0.002-0.06mm)*	%	45	10	62	69	47	54
Clay (<0.002mm)*	%	16	6	30	22	20	32

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Soil Analysis Results

Sample Name:		A7 - B	A8 - A	A8 - B	A8 - C	A9 - A	A9 - B
Lab Number:		3140507.19	3140507.20	3140507.21	3140507.22	3140507.23	3140507.24
Sample Type:		SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor
Sample Type Code:		S10	S10	S10	S10	S10	S10
pH	pH Units	5.1	6.4	6.6	6.4	5.3	5.1
Olsen Phosphorus	mg/L	4	40	3	4	29	36
Potassium	me/100g	0.16	0.92	0.15	0.13	0.24	0.16
Potassium	%BS	0.9	5.8	1.6	1.4	0.5	0.2
Potassium	MAF units	3	19	4	3	3	< 1
Calcium	me/100g	3.7	8.7	4.6	4.0	22.5	29.5
Calcium	%BS	22	55	47	43	43	35
Calcium	MAF units	4	11	7	6	15	11
Magnesium	me/100g	1.72	2.21	2.99	3.41	1.80	5.76
Magnesium	%BS	10.2	13.9	30.9	36.2	3.4	6.8
Magnesium	MAF units	33	49	81	89	22	38
Sodium	me/100g	0.25	0.17	0.25	0.22	0.24	0.87
Sodium	%BS	1.5	1.1	2.6	2.3	0.5	1.0
Sodium	MAF units	10	8	14	12	6	12
CEC	me/100g	17	16	10	9	53	85
Total Base Saturation	%	35	76	82	83	47	43
Volume Weight	g/mL	0.86	0.99	1.20	1.17	0.55	0.29
Soluble Salts (Field)	%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.14
EC (in 1:5 Extract)	mS/cm	0.05	0.02	< 0.01	< 0.01	0.10	0.39
Organic Matter (LOI)*	g/100g dry wt	4.8	7.9	2.7	2.8	51.2	-
Total Nitrogen	%	0.28	0.24	< 0.04	< 0.04	1.52	0.99
Total Organic Carbon*	g/100g dry wt	11.2	2.2	0.23	0.18	23	27
Phosphorus (Mehlich 3)*	mg/L	6	67	6	1	45	54
Potassium (Mehlich 3)*	mg/L	47	310	62	60	49	15
Calcium (Mehlich 3)*	mg/L	585	1,514	950	923	2,130	1,449
Magnesium (Mehlich 3)*	mg/L	166.7	245	379	472	109.4	176.2
Sodium (Mehlich 3)*	mg/L	44	37	61	58	30	51
Sulphur (Mehlich 3)*	mg/L	42	15	27	37	29	69
Iron (Mehlich 3)*	mg/L	462	255	140	174	433	488
Manganese (Mehlich 3)*	mg/L	12.8	10.5	6.9	52.1	19.6	47.4

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Phone:	06 359 3099	**Submitted By:**	Katie Beecroft

Soil Analysis Results

Sample Name:		A7 - B	A8 - A	A8 - B	A8 - C	A9 - A	A9 - B
Lab Number:		3140507.19	3140507.20	3140507.21	3140507.22	3140507.23	3140507.24
Sample Type:		SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor
Sample Type Code:		S10	S10	S10	S10	S10	S10
Zinc (Mehlich 3)*	mg/L	2.9	3.4	1.0	0.6	6.0	2.3
Copper (Mehlich 3)*	mg/L	1.4	2.4	1.5	0.7	1.7	< 0.2
Boron (Mehlich 3)*	mg/L	0.15	0.50	< 0.15	< 0.15	0.31	0.60
Cobalt (Mehlich 3)*	mg/L	0.3	0.2	0.2	0.8	0.3	0.3
Aluminium (Mehlich 3)*	mg/L	844	892	906	856	1,054	781
'Total' Phosphorus	mg/kg	147	550	< 65	93	1,818	826
Sand (0.06-2mm)*	%	9	6	8	27	25	-
Silt (0.002-0.06mm)*	%	62	62	70	56	32	-
Clay (<0.002mm)*	%	29	32	21	17	42	-

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Phone:	06 359 3099	**Submitted By:**	Katie Beecroft

Soil Analysis Results

Sample Name:		A10 - A	A10 - B	A11 - A	A11 - B	A11 - C	A12 - A
Lab Number:		3140507.25	3140507.26	3140507.27	3140507.28	3140507.29	3140507.30
Sample Type:		SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor
Sample Type Code:		S10	S10	S10	S10	S10	S10
pH	pH Units	5.5	4.6	6.0	6.1	6.0	5.7
Olsen Phosphorus	mg/L	56	63	18	14	5	17
Potassium	me/100g	2.47	1.06	0.11	0.20	0.16	0.12
Potassium	%BS	5.8	1.4	0.6	2.0	1.5	0.8
Potassium	MAF units	31	7	2	5	4	3
Calcium	me/100g	15.2	22.2	10.7	3.9	4.3	7.7
Calcium	%BS	36	30	55	39	41	53
Calcium	MAF units	12	9	13	6	6	11
Magnesium	me/100g	3.47	6.29	1.61	2.78	3.41	0.79
Magnesium	%BS	8.2	8.6	8.2	28.3	32.5	5.4
Magnesium	MAF units	48	46	36	72	89	20
Sodium	me/100g	0.51	1.28	0.22	0.23	0.21	0.10
Sodium	%BS	1.2	1.7	1.1	2.4	2.0	0.7
Sodium	MAF units	15	19	10	12	11	5
CEC	me/100g	42	73	20	10	10	15
Total Base Saturation	%	51	42	65	72	77	60
Volume Weight	g/mL	0.62	0.33	0.99	1.16	1.16	1.11
Soluble Salts (Field)	%	0.08	0.64	< 0.05	< 0.05	< 0.05	< 0.05
EC (in 1:5 Extract)	mS/cm	0.24	1.83	0.04	< 0.01	0.01	< 0.01
Organic Matter (LOI)*	g/100g dry wt	40.1	-	16.2	3.6	2.7	6.6
Total Nitrogen	%	1.08	0.85	0.35	< 0.04	< 0.04	0.31
Total Organic Carbon*	g/100g dry wt	17.5	25	6.7	0.48	0.13	2.0
Phosphorus (Mehlich 3)*	mg/L	91	84	45	30	3	115
Potassium (Mehlich 3)*	mg/L	507	111	41	79	64	45
Calcium (Mehlich 3)*	mg/L	1,528	1,266	1,936	785	890	1,502
Magnesium (Mehlich 3)*	mg/L	221	220	181.9	349	435	98.0
Sodium (Mehlich 3)*	mg/L	66	84	44	55	51	24
Sulphur (Mehlich 3)*	mg/L	51	608	28	35	56	20
Iron (Mehlich 3)*	mg/L	505	527	319	202	162	224
Manganese (Mehlich 3)*	mg/L	18.5	39.0	3.5	4.9	37.0	4.2

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		Order No:		
		Client Reference:		
Phone:	06 359 3099	**Submitted By:**	Katie Beecroft	

Soil Analysis Results

Sample Name:		A10 - A	A10 - B	A11 - A	A11 - B	A11 - C	A12 - A
Lab Number:		3140507.25	3140507.26	3140507.27	3140507.28	3140507.29	3140507.30
Sample Type:		SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor	SOIL General, Outdoor
Sample Type Code:		S10	S10	S10	S10	S10	S10
Zinc (Mehlich 3)*	mg/L	6.4	4.1	2.5	1.0	< 0.5	1.2
Copper (Mehlich 3)*	mg/L	2.1	0.5	2.5	1.3	0.6	0.7
Boron (Mehlich 3)*	mg/L	0.53	0.31	0.28	< 0.15	< 0.15	0.35
Cobalt (Mehlich 3)*	mg/L	0.3	1.3	0.2	< 0.1	0.9	< 0.1
Aluminium (Mehlich 3)*	mg/L	1,025	1,002	1,130	1,127	803	1,219
'Total' Phosphorus	mg/kg	1,858	1,302	595	124	125	700
Sand (0.06-2mm)*	%	17	-	9	10	11	60
Silt (0.002-0.06mm)*	%	40	-	59	66	69	24
Clay (<0.002mm)*	%	43	-	33	24	20	16

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		Order No:	
		Client Reference:	
Phone:	06 359 3099	**Submitted By:**	Katie Beecroft

Soil Analysis Results

Sample Name:		A12 - B	A12 - C				
Lab Number:		3140507.31	3140507.32				
Sample Type:		SOIL General, Outdoor	SOIL General, Outdoor				
Sample Type Code:		S10	S10				
pH	pH Units	5.9	6.2	-	-	-	-
Olsen Phosphorus	mg/L	16	13	-	-	-	-
Potassium	me/100g	0.09	0.14	-	-	-	-
Potassium	%BS	1.2	2.3	-	-	-	-
Potassium	MAF units	2	3	-	-	-	-
Calcium	me/100g	3.5	2.8	-	-	-	-
Calcium	%BS	45	47	-	-	-	-
Calcium	MAF units	6	4	-	-	-	-
Magnesium	me/100g	0.49	0.75	-	-	-	-
Magnesium	%BS	6.4	12.7	-	-	-	-
Magnesium	MAF units	14	21	-	-	-	-
Sodium	me/100g	0.06	0.08	-	-	-	-
Sodium	%BS	0.7	1.3	-	-	-	-
Sodium	MAF units	3	4	-	-	-	-
CEC	me/100g	8	6	-	-	-	-
Total Base Saturation	%	54	64	-	-	-	-
Volume Weight	g/mL	1.28	1.22	-	-	-	-
Soluble Salts (Field)	%	< 0.05	< 0.05	-	-	-	-
EC (in 1:5 Extract)	mS/cm	< 0.01	< 0.01	-	-	-	-
Organic Matter (LOI)*	g/100g dry wt	2.9	-	-	-	-	-
Total Nitrogen	%	0.06	0.05	-	-	-	-
Total Organic Carbon*	g/100g dry wt	0.60	0.52	-	-	-	-
Phosphorus (Mehlich 3)*	mg/L	106	83	-	-	-	-
Potassium (Mehlich 3)*	mg/L	40	63	-	-	-	-
Calcium (Mehlich 3)*	mg/L	813	680	-	-	-	-
Magnesium (Mehlich 3)*	mg/L	67.0	109.9	-	-	-	-
Sodium (Mehlich 3)*	mg/L	17	23	-	-	-	-
Sulphur (Mehlich 3)*	mg/L	15	12	-	-	-	-
Iron (Mehlich 3)*	mg/L	118	136	-	-	-	-
Manganese (Mehlich 3)*	mg/L	1.8	10.6	-	-	-	-

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Phone:	06 359 3099	**Submitted By:**	Katie Beecroft	

Soil Analysis Results

Sample Name:		A12 - B	A12 - C				
Lab Number:		3140507.31	3140507.32				
Sample Type:		SOIL General, Outdoor	SOIL General, Outdoor				
Sample Type Code:		S10	S10				
Zinc (Mehlich 3)*	mg/L	0.5	0.8	-	-	-	-
Copper (Mehlich 3)*	mg/L	0.5	1.2	-	-	-	-
Boron (Mehlich 3)*	mg/L	0.16	0.15	-	-	-	-
Cobalt (Mehlich 3)*	mg/L	< 0.1	0.3	-	-	-	-
Aluminium (Mehlich 3)*	mg/L	1,464	1,259	-	-	-	-
'Total' Phosphorus	mg/kg	569	473	-	-	-	-
Sand (0.06-2mm)*	%	89	89	-	-	-	-
Silt (0.002-0.06mm)*	%	5	5	-	-	-	-
Clay (<0.002mm)*	%	6	6	-	-	-	-

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Analyst's Comments

The Soil Texture tests for sample 24 (A9-B) and 26 (A10-B) have been cancelled due to insufficient sample available. Ash and Organic Matter for samples 11, 24, 26 & 32 have been cancelled due to insufficient sample.

Samples 1-32 Comment:
For further information about this test, please refer to our Technical Note - Soil Texture Measurement as published on the Hill Laboratories website.

Samples 1-32 Comment:
The Mehlich 3 B test is considered to be a reliable measure for soils with moderate or high B status. For soils with low B levels, the test is less reliable, and must be interpreted with appropriate caution. Plant herbage (leaf) B levels should be considered before recommending boron application.

Samples 1-32 Comment:
As the Mehlich 3 test is an acid extraction it is not measuring plant available Al, but the dilute acid soluble Al. This tends to be the amorphous, non-crystalline Al, i.e. that Al likely to fix applied soluble P. In-house investigations have shown reasonable correlation between m3-Al and the Anion Storage Capacity (Phosphate Retention) test. M3-Al does not determine the likelihood of aluminium toxicity. Please refer to the laboratory Technical Note: Mehlich 3 Soil Test for further information.

Samples 1-32 Comment:
The medium range shown describes typical 'Total' Phosphorus levels for mineral soils in New Zealand. The 'Total' P test has not been correlated against pasture growth response rates so should be interpreted along with other observations.

Samples 2-3, 6-9, 11-14, 16-17, 21-22, 28-29, 31-32 Comment:
The low CEC level found in this soil indicates that it can only retain cation nutrients (potassium, calcium, magnesium and sodium) at low levels. The normal ranges and the derived histograms are based on a typical soil with a CEC level between 12 and 25 me/100g.

Samples 23-26 Comment:
The high CEC level found in this soil indicates that it has a high capacity to retain cation nutrients (potassium, calcium, magnesium and sodium). For crop and horticulture soil sample type codes, the normal ranges and the derived histograms are based on a typical soil with a CEC level between 12 and 25 me/100g, unless otherwise denoted.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Sample Registration*	Samples were registered according to instructions received.	-	1-32
Soil Prep (Dry & Grind)*	Air dried at 35 - 40°C overnight (residual moisture typically 4%) and crushed to pass through a 2mm screen.	-	1-32
pH	1:2 (v/v) soil:water slurry followed by potentiometric determination of pH. In-house.	0.1 pH Units	1-32
Olsen Phosphorus	Olsen extraction followed by Molybdenum Blue colorimetry. In-house method.	1 mg/L	1-32
Potassium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	1 MAF units	1-32
Calcium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	1 MAF units	1-32

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Phone:	06 359 3099	**Submitted By:**	Katie Beecroft

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Magnesium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	1 MAF units	1-32
Sodium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	2 MAF units	1-32
Total Nitrogen	Dumas combustion. In-house.	0.04 %	1-32
Organic Matter (LOI)*	Calculation from Ash: 100 - Ash (dry wt). Ash result obtained by measuring weight loss after ignition in muffle furnace at 550°C for 6 hours.	0.1 g/100g dry wt	1-10, 12-23, 25, 27-31
Soluble Salts (Field)	1:5 soil:water extraction followed by potentiometric determination of conductivity (25°C). Calculated by EC (mS/cm) x 0.35. In-house.	0.05 %	1-32
EC (in 1:5 Extract)	Electrical Conductivity measured in 1:5 Soil:Water extract (25° C).	0.01 mS/cm	1-32
Phosphorus (Mehlich 3)*	Mehlich 3 Extraction followed by ICP-OES.	1 mg/L	1-32
Sulphur (Mehlich 3)*	Mehlich 3 Extraction followed by ICP-OES.	1 mg/L	1-32
Potassium (Mehlich 3)*	Mehlich 3 Extraction followed by ICP-OES.	1 mg/L	1-32
Calcium (Mehlich 3)*	Mehlich 3 Extraction followed by ICP-OES.	2 mg/L	1-32
Magnesium (Mehlich 3)*	Mehlich 3 Extraction followed by ICP-OES.	1.0 mg/L	1-32
Sodium (Mehlich 3)*	Mehlich 3 Extraction followed by ICP-OES.	2 mg/L	1-32
Iron (Mehlich 3)*	Mehlich 3 Extraction followed by ICP-OES.	1 mg/L	1-32
Manganese (Mehlich 3)*	Mehlich 3 Extraction followed by ICP-OES.	0.2 mg/L	1-32
Zinc (Mehlich 3)*	Mehlich 3 Extraction followed by ICP-OES.	0.5 mg/L	1-32
Copper (Mehlich 3)*	Mehlich 3 Extraction followed by ICP-OES.	0.2 mg/L	1-32
Boron (Mehlich 3)*	Mehlich 3 Extraction followed by ICP-OES.	0.15 mg/L	1-32
Cobalt (Mehlich 3)*	Mehlich 3 Extraction followed by ICP-OES.	0.1 mg/L	1-32
Aluminium (Mehlich 3)*	Mehlich 3 Extraction followed by ICP-OES.	1 mg/L	1-32
'Total' Phosphorus	Nitric/hydrochloric digestion (based on US EPA 200.2) followed by ICP-OES. (Total recoverable nutrients reported on a dry weight basis) The levels from this method are referred to as 'Totals' in quotation marks, as they will be a slight under-estimation of the true Totals for some elements. In-house.	65 mg/kg	1-32
Potassium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	0.01 me/100g	1-32
Calcium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	0.5 me/100g	1-32
Magnesium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	0.04 me/100g	1-32
Sodium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	0.05 me/100g	1-32
Potassium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	0.1 %BS	1-32
Calcium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	1 %BS	1-32
Magnesium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	0.2 %BS	1-32
Sodium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	0.1 %BS	1-32

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Certificate of Analysis

Client:	Lowe Environmental Impact Limited	**Lab No:**	3140507	svgpv1
Address:	PO Box 4667 Palmerston North 4442	**Date Received:**	19-Dec-2022	
		Date Reported:	16-Jan-2023	
		Quote No:	120495	
		Order No:		
		Client Reference:		
Phone:	06 359 3099	**Submitted By:**	Katie Beecroft	

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
CEC	Summation of extractable cations (K, Ca, Mg, Na) and extractable acidity. May be overestimated if soil contains high levels of soluble salts or carbonates. In-house.	2 me/100g	1-32
Total Base Saturation	Calculated from Extractable Cations and Cation Exchange Capacity.	5 %	1-32
Volume Weight	The weight/volume ratio of dried, ground soil. In-house.	0.01 g/mL	1-32
Sand (0.06-2mm)*	Sieve analysis after organic matter removal. In-house.	2 %	1-23, 25, 27-32
Silt (0.002-0.06mm)*	Sedimentation procedure by hydrometer after organic matter removal. In-house.	2 %	1-23, 25, 27-32
Clay (<0.002mm)*	Sedimentation procedure by hydrometer after organic matter removal. In-house.	2 %	1-23, 25, 27-32
Total Organic Carbon*	Acid pretreatment to remove carbonates present followed by Catalytic Combustion (900°C, O2), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1-32

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 19-Dec-2022 and 12-Jan-2023. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

Andrew Whitmore BSc (Tech)
Client Services Manager

SOIL CORE LOG A1

PROJECT NUMBER 10862
PROJECT NAME Arawhata Farms
CLIENT Horizons Regional Council
LOCATION DESCRIPTION Top site
DATE 13/12/2022

DRILL CO./DRILLER LEI
DRILLING METHOD Hand Auger

TOTAL DEPTH 3m
WATER LEVEL Not Reached
COORDINATES -40.639971; 175.227497
COORDINATE TYPE WGS84

COMMENTS Soil cores obtained by Hand Auger

LOGGED BY Eise Venter and Bruce Bycroft
CHECKED BY

Depth (m)	Water	Graphic Log	Material Description
0			SILT; Brown; Homogeneous; Soft; Moist; Low Plasticity.
0.2			SILT; Yellowish Brown; Homogeneous; Soft; Moist; Low Plasticity.
0.4			Clayey SILT; Yellowish Brown, Mottled orangey; Homogeneous; Firm; Moist; Low Plasticity.
0.6			
0.8			Clayey SILT; Light Brown, Mottled orangey; Homogeneous; Firm; Moist; Low Plasticity.
1			
1.2			Clayey SILT; Yellowish Brown, Slightly mottled Yellow; Homogeneous; Firm; Moist; Low Plasticity.
1.4			
1.6			
1.8			
2			SAND; Yellowish Brown; Homogeneous; Very Soft; Moist; Low Plasticity.
2.2			
2.4			
2.6			
2.8			
3			Soil Core Ends at 3.00m

SOIL CORE LOG A2

PROJECT NUMBER 10862
PROJECT NAME Arawhata Farms
CLIENT Horizons Regional Council
LOCATION DESCRIPTION Hay Shed
DATE 13/12/2022

DRILL CO./DRILLER LEI
DRILLING METHOD Hand Auger

TOTAL DEPTH 2m
WATER LEVEL 2m
COORDINATES -40.638136; 175.229009
COORDINATE TYPE WGS84

COMMENTS Soil cores obtained by Hand Auger

LOGGED BY Eise Venter and Bruce Bycroft
CHECKED BY

Depth (m)	Water	Graphic Log	Material Description
0			SILT; Brown; Homogeneous; Soft; Moist; Low Plasticity.
0.2			Silty CLAY; Brown Grey, Mottled dark Brown,Reddish Orange; Homogeneous; Firm; Moist; High Plasticity.
0.4			
0.6			Silty CLAY; Greyish Orange; Homogeneous; Stiff; Moist; High Plasticity.
0.8			
1			SAND with Silt; Light Brown; Homogeneous; Soft; Moist; Low Plasticity.
1.2			Sandy SILT; Yellowish Light Brown; Homogeneous; Soft; Moist; Low Plasticity.
1.4			
1.6			Silty SAND; Brown; Homogeneous; Soft; Moist; Low Plasticity.
1.8			Silty SAND; Brown; Homogeneous; Soft; Wet; Low Plasticity.
2	▽		Soil Core Ends at 2.00m
2.2			
2.4			
2.6			
2.8			
3			

SOIL CORE LOG A3

PROJECT NUMBER 10862
PROJECT NAME Arawhata Farms
CLIENT Horizons Regional Council
LOCATION DESCRIPTION Joblins Above
DATE 13/12/2022

DRILL CO./DRILLER LEI
DRILLING METHOD Hand Auger

TOTAL DEPTH 1.50m
WATER LEVEL 1.35m
COORDINATES -40.638047; 175.232049
COORDINATE TYPE WGS84

COMMENTS Soil cores obtained by Hand Auger

LOGGED BY Eise Venter and Bruce Bycroft
CHECKED BY

Depth (m)	Water	Graphic Log	Material Description
0.2			Clayey SILT; Brown; Homogeneous; Soft; Moist; Low Plasticity.
0.4			Silty CLAY; Yellowish Light Grey, Mottled Orangey; Homogeneous; Firm; Moist; High Plasticity.
0.6			
0.8			SAND with minor silt; Brown; Homogeneous; Soft; Moist; Low Plasticity; Fine Gravel & Sand.
1			SAND with minor silt; Brown; Homogeneous; Soft; Saturated; Low Plasticity; Fine Gravel & Sand.
1.2			SAND with minor silt; Brown; Homogeneous; Soft; Moist; Low Plasticity; Fine Gravel & Sand.
1.4	▽		Silty SAND; Reddish Brown, Black Mottles; Homogeneous; Soft; Moist; Low Plasticity; Fine Gravel & Sand.
1.6			Soil Core Ends at 1.5m
1.8			
2			
2.2			
2.4			
2.6			
2.8			
3			

SOIL CORE LOG A4

PROJECT NUMBER 10862
PROJECT NAME Arawhata Farms
CLIENT Horizons Regional Council
LOCATION DESCRIPTION Buried Drain
DATE 13/12/2022

DRILL CO./DRILLER LEI
DRILLING METHOD Hand Auger

TOTAL DEPTH 0.80m
WATER LEVEL 0.55m
COORDINATES -40.634696; 175.232617
COORDINATE TYPE WGS84

COMMENTS Soil cores obtained by Hand Auger

LOGGED BY Eise Venter and Bruce Bycroft
CHECKED BY

Depth (m)	Water	Graphic Log	Material Description
0.2			CLAYEY SILT; Dark Brown; Homogeneous; Soft; Moist; Low Plasticity.
			CLAY with some silt; Greyish Dark Brown, Silt Mottled Dark Orange; Homogeneous; Soft; Moist; High Plasticity.
0.4			CLAY; Grey, Mottled Dark Orange; Homogeneous; Very Soft; Moist; High Plasticity.
0.6	▽		CLAY with minor silt; Light Grey, Mottled Orange; Homogeneous; Very Soft; Moist; High Plasticity.
0.8			Soil Core Ends at 0.8m
1			
1.2			
1.4			
1.6			
1.8			
2			
2.2			
2.4			
2.6			
2.8			
3			

SOIL CORE LOG A5-2

PROJECT NUMBER 10862
PROJECT NAME Arawhata Farms
CLIENT Horizons Regional Council
LOCATION DESCRIPTION Joblins
DATE 14/12/2022

DRILL CO./DRILLER LEI
DRILLING METHOD Hand Auger

TOTAL DEPTH 1.30m
WATER LEVEL Not Reached
COORDINATES -40.633757; 175.236255
COORDINATE TYPE WGS84

COMMENTS Soil cores obtained by Hand Auger.

LOGGED BY Eise Venter and Bruce Bycroft
CHECKED BY

Depth (m)	Water	Graphic Log	Material Description
0			SILT; Darkish Brown, Minor mottling light & dark Orange; Homogeneous; Firm; Moist; Low Plasticity.
0.2			Clayey SILT; Light Brown, Major mottling dark Orange; Homogeneous; Firm; Moist; Low Plasticity.
0.4			
0.6			Clayey SILT; Light Brown, Extensive mottling dark Orange; Homogeneous; Firm; Moist; Low Plasticity.
0.8			
1			SAND with minor silt; Reddish Light Brown; Homogeneous; Soft; Moist; Low Plasticity.
1.2			SAND; Brown; Homogeneous; Soft; Moist; Low Plasticity; Fine Sand.
1.4			Soil Core Ends at 1.3m
1.6			
1.8			
2			
2.2			
2.4			
2.6			
2.8			
3			

SOIL CORE LOG A6

PROJECT NUMBER 10862
PROJECT NAME Arawhata Farms
CLIENT Horizons Regional Council
LOCATION DESCRIPTION Joblins Below
DATE 14/12/2022

DRILL CO./DRILLER LEI
DRILLING METHOD Hand Auger

TOTAL DEPTH 1.33m
WATER LEVEL Not Reached
COORDINATES -40.630974; 175.237900
COORDINATE TYPE WGS84

COMMENTS Soil cores obtained by Hand Auger.

LOGGED BY Eise Venter and Bruce Bycroft
CHECKED BY

Depth (m)	Water	Graphic Log	Material Description
0			SILT; Dark Brown, Minor mottling light Brown; Homogeneous; Firm; Moist; Low Plasticity.
0.2			CLAY with minor silt; Light Grey, Mottled dark Orange and dark Brown; Homogeneous; Firm; Moist; High Plasticity.
0.4			
0.6			CLAY with minor silt; Light Grey, Mottled Orange; Homogeneous; Firm; Moist; High Plasticity.
0.8			
1			
1.2			Sandy CLAY with minor silt; Orange and Grey; Heterogeneous; Soft; Moist; High Plasticity.
			Sandy & Gravelly CLAY with minor silt; Orangey Brown; Heterogeneous; Soft; Moist; High Plasticity; Fine to Coarse Sand, Gravel Subrounded to Subangular Largest 16mm.
1.4			Soil Core Ends at 1.33m
1.6			
1.8			
2			
2.2			
2.4			
2.6			
2.8			
3			

SOIL CORE LOG A7

PROJECT NUMBER 10862
PROJECT NAME Arawhata Farms
CLIENT Horizons Regional Council
LOCATION DESCRIPTION Bund End
DATE 14/12/2022

DRILL CO./DRILLER LEI
DRILLING METHOD Hand Auger

TOTAL DEPTH 1.00m
WATER LEVEL 0.65m
COORDINATES -40.628837, 175.237269
COORDINATE TYPE WGS84

COMMENTS Soil cores obtained by Hand Auger.

LOGGED BY Eise Venter and Bruce Bycroft
CHECKED BY

Depth (m)	Water	Graphic Log	Material Description
0			SILT with some gravel; Brown; Heterogeneous; Soft; Moist; Low Plasticity; Subangular 18mm Max Gravel.
0.2			Clayey SILT with trace of gravel; Dark Brown; Heterogeneous; Firm; Moist; Low Plasticity; Subangular 28mm Max Gravel.
0.4			Clayey SILT; Brownish Black; Homogeneous; Soft; Moist; Low Plasticity.
0.6	▽		
0.8			CLAY; Brownish Grey; Homogeneous; Very Soft; Wet; High Plasticity.
1			CLAY; Greenish Grey; Homogeneous; Soft; Wet; High Plasticity.
1.2			Soil Core Ends at 1.0m
1.4			
1.6			
1.8			
2			
2.2			
2.4			
2.6			
2.8			
3			

SOIL CORE LOG A8

PROJECT NUMBER 10862
PROJECT NAME Arawhata Farms
CLIENT Horizons Regional Council
LOCATION DESCRIPTION Milking shed
DATE 14/12/2022

DRILL CO./DRILLER LEI
DRILLING METHOD Hand Auger

TOTAL DEPTH 1.32m
WATER LEVEL 1.30m
COORDINATES -40.627125; 175.242472
COORDINATE TYPE WGS84

COMMENTS Soil cores obtained by Hand Auger.

LOGGED BY Eise Venter and Bruce Bycroft
CHECKED BY

Depth (m)	Water	Graphic Log	Material Description
0			SILT; Dark Brown; Homogeneous; Firm; Moist; Low Plasticity.
0.2			Silty CLAY; Light Brown, Mottled few dark Orange but mostly Light Orange; Homogeneous; Stiff; Moist; High Plasticity.
0.4			
0.6			Silty CLAY; Greyish Light Brown, Mottled dark to light Orange; Homogeneous; Firm; Moist; High Plasticity.
0.8			
1			Silty CLAY; Greyish Light Brown, Major mottled dark to light Orange; Homogeneous; Firm; Moist; High Plasticity.
1.2	▽		Silty CLAY with trace of gravel; Light Greyish Orange; Heterogeneous; Firm; Moist; High Plasticity. Gravelly CLAY with minor silt and trace of sand; Reddish Brown; Heterogeneous; Soft; Wet; High Plasticity; Subgrounded to Subangular Gravel 15mm Max, Medium to Coarse Sand.
1.4			Soil Core Ends at 1.32m
1.6			
1.8			
2			
2.2			
2.4			
2.6			
2.8			
3			

SOIL CORE LOG A9

PROJECT NUMBER 10862
PROJECT NAME Arawhata Farms
CLIENT Horizons Regional Council
LOCATION DESCRIPTION Ferry side
DATE 14/12/2022

DRILL CO./DRILLER LEI
DRILLING METHOD Hand Auger

TOTAL DEPTH 0.70m
WATER LEVEL 0.71m
COORDINATES -40.622826; 175.240085
COORDINATE TYPE WGS84

COMMENTS Soil cores obtained by Hand Auger.

LOGGED BY Eise Venter and Bruce Bycroft
CHECKED BY

Depth (m)	Water	Graphic Log	Material Description
0			Clayey SILT; Dark Brown; Homogeneous; Soft; Moist; Low Plasticity.
0.2			Clayey SILT with trace of gravel; Blackish Brown; Heterogeneous; Soft; Moist; Low Plasticity; Gravel Subangular 6mm.
0.4			Clayey SILT; Brownish Black; Homogeneous; Very Soft; Moist; Low Plasticity; Organic Matter, Sulfur smell.
0.6	▽		Clayey SILT with trace of sand; Brownish Black; Heterogeneous; Very Soft; Wet; Low Plasticity; Fine Sand, More organic matter than above 40%.
0.8			Soil Core Ends at 0.70m
1			
1.2			
1.4			
1.6			
1.8			
2			
2.2			
2.4			
2.6			
2.8			
3			

SOIL CORE LOG A10

PROJECT NUMBER 10862
PROJECT NAME Arawhata Farms
CLIENT Horizons Regional Council
LOCATION DESCRIPTION Pump shed
DATE 14/12/2022

DRILL CO./DRILLER LEI
DRILLING METHOD Hand Auger

TOTAL DEPTH 0.70m
WATER LEVEL 0.66m
COORDINATES -40.623469; 175.242491
COORDINATE TYPE WGS84

COMMENTS Soil cores obtained by Hand Auger.

LOGGED BY Eise Venter and Bruce Bycroft
CHECKED BY

Depth (m)	Water	Graphic Log	Material Description
0			SILT; Brown; Homogeneous; Firm; Moist; Low Plasticity.
0.2			Clayey SILT with trace of Sand; Blackish Brown; Homogeneous; Soft; Moist; Low Plasticity; Medium Sand, Organic material (orangey)50%.
0.4			
0.6	▽		
0.8			Soil Core Ends at 0.70m
1			
1.2			
1.4			
1.6			
1.8			
2			
2.2			
2.4			
2.6			
2.8			
3			

SOIL CORE LOG A11

PROJECT NUMBER 10862
PROJECT NAME Arawhata Farms
CLIENT Horizons Regional Council
LOCATION DESCRIPTION Hokio beach road
DATE 14/12/2022

DRILL CO./DRILLER LEI
DRILLING METHOD Hand Auger

TOTAL DEPTH 1.30m
WATER LEVEL 0.58m
COORDINATES -40.623470; 175.245053
COORDINATE TYPE WGS84

COMMENTS Soil cores obtained by Hand Auger.

LOGGED BY Eise Venter and Bruce Bycroft
CHECKED BY

Depth (m)	Water	Graphic Log	Material Description
0			SILT; Dark Brown; Homogeneous; Firm; Moist; Low Plasticity.
0.2			CLAY with minor silt; Light Brown, Mottled dark orange; Homogeneous; Firm; Moist; High Plasticity.
0.4			CLAY; Light Some Dark Brown, Mottled orange; Homogeneous; Soft; Moist; High Plasticity.
0.6	▽		CLAY; Light Brown, Mottled orange; Homogeneous; Soft; Moist; High Plasticity.
0.8			CLAY; Greenish Grey, Mottled orange; Heterogeneous; Very Soft; Moist; High Plasticity; Light and Dark Green Organic Material.
1			CLAY; Greyish Orange; Homogeneous; Stiff; Wet; High Plasticity.
1.2			Gravelly CLAY; Brownish Yellow, Heterogeneous; Very Soft, Saturated, High Plasticity; Gravel 20mm max.
1.4			Soil Core Ends at 1.30m
1.6			
1.8			
2			
2.2			
2.4			
2.6			
2.8			
3			

SOIL CORE LOG A12

PROJECT NUMBER 10862
PROJECT NAME Arawhata Farms
CLIENT Horizons Regional Council
LOCATION DESCRIPTION Makomako
DATE 14/12/2022

DRILL CO./DRILLER LEI
DRILLING METHOD Hand Dug Hole

TOTAL DEPTH 1.2m
WATER LEVEL Not Reached
COORDINATES -40.619967; 175.251203
COORDINATE TYPE WGS84

COMMENTS Soil cores obtained by Hand Dug Hole.

LOGGED BY Eise Venter and Bruce Bycroft
CHECKED BY

Depth (m)	Water	Graphic Log	Material Description
0			Gravelly SILT with some Sand; Light Brown; Heterogeneous; Firm; Dry; Low Plasticity; Subrounded to Subangular Gravel 60mm, Fine Sand.
0.2			Cobbly SILT with some Sand; Very Light Brown; Heterogeneous; Firm; Dry; Low Plasticity; Subangular Cobble up to 160mm, Medium to Coarse Sand.
0.4			Sandy GRAVEL with some Silt; Brown; Heterogeneous; Tightly Packed; Dry; Low Plasticity; Subangular Gravel 95mm, Fine to Coarse Sand.
0.6			Sandy GRAVEL; Brown; Heterogeneous; Tightly Packed; Dry; Low Plasticity; Subrounded to Subangular Gravel 95mm, Fine to Coarse Sand.
0.8			Sandy GRAVEL; Brown; Heterogeneous; Tightly Packed; Moist; Low Plasticity; Subrounded to Subangular Gravel 120mm, Fine to Coarse Sand.
1			Sandy GRAVEL; Brown; Heterogeneous; Tightly Packed; Moist; Low Plasticity; Subrounded to Subangular Gravel 100mm, Medium to Coarse Sand; Black silty clayish layer on rocks.
1.2			Sandy GRAVEL; Brown; Heterogeneous; Tightly Packed; Very Moist; Low Plasticity; Subrounded to Rounded Gravel up to 130mm, Fine to Coarse Sand.
1.4			Soil Core Ends at 1.20m
1.6			
1.8			
2			
2.2			
2.4			
2.6			
2.8			
3			

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